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Good Grazing Management Pays	*Southern Planter*	1
New Sterilizer for Dairy Utensils	*Michigan Farmer*	5
Michels' Hybrid Grass	*Country Gentleman*	7
The Interpretation of Soil Tests	*Dr. M. F. Morgan*	12
The Home Orchard	*Gardeners' Chronicle*	19
Freedom for More Profitable Work	*The Furrow*	23
Fertilizers for Better Asparagus	*N. J. Farm and Garden*	26
Grass—Guardian of Soil	*Nebraska Farmer*	30
Grazing Crops for Poultry	*American Poultry Journal*	32
Plowing Pasture Furrows	*Missouri Ruralist*	35
Cold Storage Lockers	*Capper's Farmer*	37
Creating a Soil Reserve for the Orchard	*Rural New Yorker*	40
Four Shoulders to the Wheel	*Successful Farming*	44
Plant Chemistry and the Farmer	*Vern A. Molstad*	47
Heavy Grain Feeding Paid	*The Farmer*	52
New Pyrocide Dust	*Market Growers Journal*	54
Regular Breeding and Vitamin E	*Breeders Gazette*	55
Water Works for the Farm	*Electricity on the Farm*	57
Boron Deficiency in Cauliflower	*Scientific Agriculture*	61
Pascal Celery Thrice Grown	*Western Farm Life*	63
Gypsum Industry in the Southwest	*Farm and Ranch*	64
Our Responsibility with Manure	*Better Crops*	66
Poison Ivy and Poison Oak Control	*American Fruit Grower*	71
Rambouillets	*Sheep Breeder*	73
How Much Calcium	*Poultry Item*	75
Lamb Feeding Experiments	*Kansas Farmer*	81
Effects of Flies and Fly Sprays on Cows	*Regan and Freeborn*	82
Calibrate the Seed Drill		88

The Farmer's Digest

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The Farmer's Digest

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Good Grazing Management Pays

Condensed from The Southern Planter

Prof. D. B. Johnstone-Wallace
Cornell University

IT is not generally realized that methods of grazing management play as important a part in pasture improvement as methods of fertilization. It is the herbage consumed by the grazing animal which is of value not the herbage which is grown. Good grazing management involves grazing methods which make it possible for a grazing animal to consume the maximum amount of feed during each day of the grazing season. The first step in learning the art of grazing management is to spend several hours in a good pasture watching the nose end of a good cow. Having observed the way in which she grazes and the type of herbage she consumes, the next step is to adopt a method of grazing management which will enable her to consume as much as possible of the type of herbage she prefers.

When stock are turned into a large field and left there continuously they usually graze part of the field bare and leave a considerable part entirely ungrazed. Even though there may be an abundance of tall herbage in the pasture they will be found day after day grazing the short leafy herbage growing in parts of the field grazed closely early in the season. Pastures grazed in this way are not efficiently used as the area ungrazed serves no useful purpose. Frequently undergrazing and overgrazing take place in the same pasture at the same time; certain sections of the pasture being so closely and continuously grazed that injury to the plants results, while other sections are injured badly by not being grazed at all.

This condition has long been known to exist. A book written in 1834 entitled "British Husbandry" indicates how farmers were endeavoring to improve practices of grazing management at that time. It says:

"As to the stocking of enclosures, it is the opinion of the most intelligent graziers that the

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grassland should be divided into four enclosures and grazed as follows:

No. 1—No stock.

No. 2—For the fattening beasts, until moved to No. 1.

No. 3—For the second best cattle, until moved to No. 2.

No. 4—For store cattle and sheep until moved to No. 3. The fattening cattle are moved to the rested enclosure each time and when this takes place the rested enclosure is divided into two by hurdles. The cattle are allowed to graze one-half for a week and the other half the following week. At the end of each fortnight they are moved to the rested enclosure. In this way each enclosure gets a fortnight's rest, and the cattle graze over the whole of the grassland in two months."

Rotation Grazing

Many years later, following the World War, this method of grazing received considerable publicity as a result of its widespread adoption in Germany. It became known as "Rotation Grazing" and it has frequently been ascribed to the work of the Hohenheim Experiment Station in Germany, although the method was widely practiced throughout Germany before the Hohenheim experiments were started. Today a similar system is practiced on most good grassland farms in Europe and on many in the northeastern states. Rotation grazing is simply a means of providing favorable conditions for the consumption of the maximum amount of feed by the grazing animals. If the farmer knows more about grazing management than his cattle it is very successful; if he knows less, it is either of no benefit or harmful.

The ideal aimed at is to permit the herbage to reach the most desirable grazing height which appears to be about 4 inches and then to graze it down to about half an inch as quickly as possible. The field is then rested for sufficient time to permit it to reach the most desirable grazing height again. Unfortunately, when milk cows are turned into a good pasture, the milk yield while the pasture is at its best is considerably higher than towards the end of the grazing period when the cows find it more difficult to gather the amount of feed needed. This has lead to a modification in the system in which the milk cows are left in the first field for a few days only, after which they are moved to the second field while dry cows and young stock are permitted to complete the grazing of the first field. The process is repeated in each of the four or more fields available. Rotation grazing is only successful when each field is closely grazed before it is rested.

Further modifications are taking place in the system in Europe

and it is now a common practice to mow some of the fields not required for grazing during the peak period of growth in May and early June, while still in a desirable leafy stage, and to make this material into silage with the aid of certain acids or molasses. In England attempts are being made to dry similar material artificially. The silage or dried material produced is used for winter feed or as a supplement to pastures during the summer when growth is insufficient.

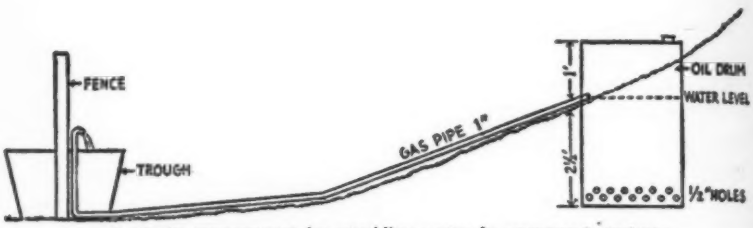
Other grazing management practices which are important are the use of the mowing machine to cut as closely as possible any herbage left ungrazed. Such material, most of which will be found in places where cattle droppings have been deposited, is consumed by the stock after it is cut if the operation is done while the stock still occupy the field. The use of a flexible grass harrow periodically to scatter cattle droppings is helpful by making the droppings beneficial instead of harmful. Pastures subject to severe winter heaving are helped by rolling in very early spring.

The major obstacles to the universal practice of rotation grazing are the expense involved in providing fencing, and the provision of a supply of water for the stock in each field. The introduction of the electric fence in recent years has made it possible to divide pastures into smaller fields at a considerably lower cost than was previously the case, but the provision of a water supply remains a difficulty. At Cornell University Dr. R. B. Hinman has solved the problem very economically in the beef cattle pastures. On the slopes of these pastures there are some wet spots which have hitherto been considered a nuisance as they remained soft and grew weeds and rushes throughout the grazing season. They have now been turned into supplies of water for cattle grazing five fields.

The procedure is simple: a 30-gallon oil drum with holes punched in the side near the bottom is sunk into the ground in the wet spot to a depth of about 2½ feet. A length of 1-inch gas pipe is then inserted in the side at the ground level as shown in the diagram. This pipe runs along the ground surface to the neighboring fence where it discharges into a trough which supplies water for three fields. A similar arrangement in another part of the same pasture supplies water for two other fields. The system works perfectly even in dry seasons and although Dr. Hinman is fortunate in having wet spots in his pastures in convenient locations, there are many farms with similar wet spots which are not being used because the farmer is not aware of the

simple solution of the problem.

Although the statement has been made that methods of grazing management are as important as methods of fertilization in pasture improvement, it must not be inferred that fertilization is unimportant. To justify the expense of fencing, the provision of a water supply, mowing, harrowing and rolling, a pasture must be productive. In New York, pastures should carry at least one cow or its equivalent per acre during the grazing season. In order to insure this it is necessary to apply sufficient superphosphate or other phosphatic fertilizer in practically all cases and to use lime and potash in addition on some soils. In a few cases it is necessary to sow seed of wild white clover also. If wild white clover and other pasture legumes are encouraged sufficiently by the methods of fertilization and grazing management practiced, the nitrogen supply takes care of itself.



A simple arrangement for providing water in permanent pastures.

Sterilize Dairy Utensils

Condensed from The Michigan Farmer

D. G. Ebinger

Extension Specialist, M. S. C.

ONE of the greatest sources of low grade dairy products and sour milk is the unsterilized utensil. The bacteria which cause this souring, production of off-flavors and sometimes sickness multiply very rapidly on the moist surfaces of unsterilized pails, strainers and cans.

The demand for higher quality dairy products has caused many farmers to sterilize all of their milk handling equipment as an insurance against loss from souring or low-grade. It has stimulated an interest in hundreds of other farmers for an effective, low-cost electric sterilizer.

It should be remembered, however, that sterilization does not take the place of washing. Utensils which have not been properly washed, commonly carry large numbers of bacteria in the particles of milk or butter-fat which remain. Utensils are much easier to wash immediately after being used rather than letting the milk or cream dry on the surface. They should first be rinsed with cold water. This prevents the milk solids from "cooking" on the utensils, reduces the amount of washing powder necessary and helps to keep the wash water clean. After thorough washing and rinsing in hot water, the utensil is ready for sterilization.

To have hot water available in the barn or milk house for washing of the utensils is quite a problem on many farms. Due to the fire hazard connected with the use of an oil, wood or coal burning stove when used in the barn or milk house, the water used for washing pails, cans and strainers is heated either on the kitchen stove or in an electric household water heater. This water may be efficiently hot to do a good washing job as it leaves the house but while being carried through the yard to the barn it rapidly loses its effectiveness.

M.S.C. Designs New Equipment

To provide hot water(180° F.) at the place where it is to be used and further provide for effective sterilization of dairy utensils, the Agricultural Engineering Section, Experiment Station, of Michigan

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State College, has designed a portable combination electric water heater and sterilizer.

This unit is a relatively simple piece of equipment, consisting of a 1,000 or 1,500 watt heating element which, excepting the top heating surface, is packed in fireproof insulation. A specially designed plate is placed over this element and fastened directly to it. This plate is one of the unique features of the unit.

Normally a heating unit is a flat plate over which a pan or pail of water is placed. This makes an effective medium provided the pan or pail has a perfectly flat bottom and makes a good contact with the heating element. The average farm pail, however, does not have a flat bottom, rather it is "dished" or may be otherwise bent. A pail with the bottom just described would not contact a heating plate in its entirety and would provide an air space between the heating plate and the area to be heated, thus effecting a layer of air between the two. To overcome this difficulty the heating surface or plate on this unit is designed with a circular depression which, in operation, is filled with water. This water is rapidly heated and is converted to steam. The steam rises, contacts the cold surface of the pail and condenses. As it condenses a drop of water is formed which drips back onto the heated plate and is again converted into steam. This process continues until the water in the pail is heated. The whole heater assembly may be mounted on tripod legs or may be built into a table.

The use of this heater fits perfectly into the operating routine of the average farm dairy. Just before starting to milk, the dairyman places approximately one-quarter pint of water in the depression built into the heating plate, places the pail of water which will later be used for washing purposes over the plate and turns on the current. The wash water is hot by the time the milking is done and the milk cooled (see chart). As the cans and pails are washed and rinsed they are inverted over the heated plate. A small amount of water is again placed on the plate by means of a funnel mounted on the side of the unit. This water is quickly converted to steam and fills the interior of the utensil with low-pressure, moist steam. With the 1,500 watt element the time required to bring the temperature of a 10-gallon can up to 200° F. is about two and one-half minutes. With this unit it is easily possible to quickly sterilize cans and other dairy utensils immediately before milking, thereby eliminating a source of bacterial contamination.

One of the chief objections to dairy equipment steam sterilizers

of the past has been the high operating cost. This new development in sterilizers is efficient. Several experimental models have been under observation for some months; one in particular has been heating 2 gallons of water twice daily plus the sterilization of cans and mechanical milking equipment for an 18 cow dairy on a monthly kilowatt hour consumption of 52.8.

Milking machines and milk utensils properly washed and adequately sterilized on the farm with a safe, clean, odorless and efficient electric water heater and sterilizer will do much toward increasing the quality of milk.

Michels' Hybrid Grass

Condensed from Country Gentleman

O. A. Fitzgerald

WHAT would you say if someone told you about a new hybrid perennial grass which produced plants big enough to graze within thirty days after the seed went into almost dry ground in the fall; which was ready to receive livestock as soon as the snow melted in the spring; which produced such a forage growth a binder could barely handle it; which, without additional moisture, started to send out succulent and generous regrowth right after cutting; which hasn't been affected by freezing winters or hot summers; and which has been perfectly satisfied with any kind of soil?

At the University of Idaho Experiment Station, Prof. C. A. Michels, the assistant agronomist, has such a grass. Now in its third generation, it has done all of those things and promises to do more. A few extremely conservative and guarded sentences in the last annual report of the Idaho Station was the first announcement of what may prove to be a ten-strike in grass breeding for range and desert country.

Within the year requests poured in from all over the world for information and seed—mostly seed—of this new hybrid. If it makes good on 50 per cent of the possibilities it has demonstrated in the three generations grown at the Idaho Station it deserves to be catalogued, in a preliminary way at least, as something of a miracle grass.

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Michels' new hybrid is from a cross between Mosida wheat, a winter variety developed some years ago by the Idaho Station, and a coarse native rye grass, *Elymus condensatus*. Mosida, the female parent, is a hard red, high-yielding variety, a vigorous grower, very winter hardy. The rye grass male parent, native to the Pacific Slope, is a typical native bunch grass, has large coarse leaves and stalks, grows about four to six feet tall even under rigorous desert conditions. It never has been regarded as an asset because livestock does not like it. The hybrid comes from what agronomists call an intergeneric cross, like crossing rye on wheat.

Diligent search of scientific literature has failed to produce any record of another hybrid like Michels' grass. It is entirely different from the perennial wheat the Russians announced some years ago and which attracted world-wide attention and started agronomists everywhere crossing wild grasses and wheat. His grass is different because he set out toward a different objective. Wanting primarily a hardy perennial cereal, the Russians crossed with wheat a wild grass similar to our Western wheat grass. Michels wanted a dual-purpose better grass which would fit into the erosion-control picture and would at the same time produce an abundant supply of palatable forage. While the grain of his hybrid offers human food possibilities for some parts of the world, this is not a strong point in America.

The fact that Michels never had seen the particular species of wild rye grass he used as a parent until he came to Idaho in 1928 to join the experiment station staff is important in the story of this hybrid. One warm summer day he was riding with a friend from Moscow, home of the central experiment station, to Lewiston. Although these towns are but forty miles apart, there is a difference of over 1,500 feet in elevation. The last ten miles literally plunged from the Palouse wheat fields 2,400 feet above the sea down to Lewiston, Idaho's lowest point, on the Clearwater River, 700 feet in elevation. On these hills the summer sun beats down with searing fury.

As he rolled down the spiral highway Michels noticed the bunches of grass which seemed to show unusual vigor and persistence but remained untouched by the livestock which had done a good job cleaning off most of the other forage. Livestock will not eat it except in the very early spring and only then when there's little else. They'll almost starve in summer before hunger drives them to tackle its sharp mature leaves and tough stalks.

Those wild rye grass plants winning out against adverse conditions on the burned Clearwater hills gave him a jolt he couldn't forget. It was about this time, too, that the seriousness of erosion began to creep into the picture. Agronomists were thinking and talking of the need for new and better grasses. Stockmen wanted more forage. Those bunches of wild rye grass clung in Michels' mind.

The Mosida wheat which the Idaho Station had developed primarily for the rigorous conditions of Northern Idaho also took his fancy. Why not cross this wheat and wild rye grass?

The first cross was made in 1931. Out of 353 crossings came only fifteen seeds. Just a few plants produced. Locating the few seeds was a tedious job. He planted those precious fifteen seeds in the greenhouse and they produced nine plants, which he set out the following spring. He covered their heads with cotton bags so they would fertilize themselves. That fall he secured about one sixteenth of a pound of seed. Only a few of the plants and a few of the heads on each fertile plant produced seeds. Out of that seed came 115 plants, which yielded enough for about a quarter of an acre.

In general the stems and leaves of Michels' hybrid are like Mosida wheat. The heads and seeds quite closely resemble common rye. The hybrid is a much bigger plant than the rye grass parent. Its root system is about midway between the two parents. It is a much more rapid grower than either. In none of the three generations has there been any throwback to either parent, so Michels conjectures that probably common rye originated from a similar hybrid.

In Professor Michels' office is a chart which shows this hybrid's possibilities as a source of hurry-up forage. A ten-day-old hybrid plant is almost identical in size with a thirty-day-old Mosida wheat plant. A thirty-day-old hybrid is big enough to graze. Last October tenth Michels planted some seed in practically dry ground at the Idaho Station and on November tenth the plants would have carried stock.

In the fall of 1936, one of the driest on record in the Palouse area, some hybrid seed went into almost dusty ground. The plants started with surprising speed and kept growing all winter under the snow. That winter provided a made-to-order test of the hybrid's winter hardiness. In January the official thermometer dropped to 30 below, which set by a 10 degree margin a new low for the forty-five years temperature records that have been kept at the home experiment station. Winter wheats, even the old stand-bys,

were hit hard by a prolonged below-zero period. Yet Michels never lost a single hybrid grass plant. When the snow melted off the next spring, lusty plants six to eight inches tall greeted him. The wild rye grass parent has contributed vigor and extreme winter hardiness to the hybrid. At the other end of the thermometer, it also seems to have the ability to adjust itself. Like the rye grass male parent it appears to take hot summers in stride just as it does cold winters. It is not particular about soil, has done well so far under adverse conditions, and actually resents pampering. Last fall Michels dug one of the original hybrid plants and a later generation, potted them and put them in the university greenhouse. In that warm and comfortable place the plants have balked.

Last summer Michels harvested a hybrid planting on the University farm. The grass headed out the middle of June, coming on with the earliest winter wheats. Although the binder was set as high as it would go the bundles still were so long it was a squeeze for them to go through the machine. Immediately following the cutting the plants began to send up new green shoots—without any additional moisture. In three generations the hybrid has shown exceptional regrowth abilities.

After hearing the interesting story of the hybrid's habits of growth as demonstrated during three generations it is difficult to control the urge to speculate in its potentialities.

Its greatest field of usefulness no doubt will be in range and desert country, where wild rye grass now grows. There it holds promise of high carrying capacity. On farms it has possibilities as a green manure crop. From results at the Idaho Station it should yield more hay than wheat.

Its ripening and seeding habits fit admirably into range and desert demands. Like ordinary wheat the heads shatter as soon as they are ripe. This is unlike the rye grass parent, which clings to much of its seed throughout the winter. The hybrid seed has demonstrated a strong tendency to start growing as soon as it hits the ground. Michels says the hybrid behaves like a typical bunch grass in spreading and that extensive natural spread is not idle speculation.

The size of the hybrid seed explains why the grass achieves such early and rapid growth, which is highly essential to survival under the exacting conditions found in most of the range and desert areas. To a large extent the size and vitality of a seedling is determined by the size of the seed and the amount of

reserve plant food it contains. Michels' grass has a seed about the same size as common rye. Because of this it produces a large and vigorous seedling with the force to establish itself speedily under unfavorable conditions. In this respect it differs from most grasses, which have small seeds and therefore a limited food supply.

Livestock like the stalks and leaves of the hybrid both in the early and mature stages. It has been fed to beef cattle, dairy cattle and sheep, alone and with other grasses. The hybrid appears to have acquired a high degree of palatability from the wheat parent. Last fall an acre was planted on the University farm to make a more thorough pasture test.

The hybrid now contains numerous types. Some have more succulent leaves and smoother stalks than others. So far livestock hasn't shown any great preference for one type over another.

Michels has made forty-eight selections from the third generation and is debating whether to pure line some of them or to leave the hybrid mixed. He is confident that it contains at least 100 different types.

This year the grass is getting a thorough trial under a wide variety of typical desert, rangeland, and cut-over land conditions in Idaho. Over a dozen farmers in selected localities have made quarter-acre plantings. As a result there is no seed for general distribution. The plan of the Agronomy department of the Idaho station is to make a small number of larger plantings under diversified conditions rather than to scatter a few ounces of seed among thousands of individuals. The grass also is being tried out in Australia, Canada and at other stations in the Pacific Northwest states.

The Interpretation of Soil Tests

M. F. Morgan

Chief Agronomist
Conn. Agri. Experiment Station

FOLLOWING the announcement of details in regard to Soil Testing Service in Circular 89 of this Station, large numbers of soil samples from fields, orchards, lawns and gardens have been examined for the citizens of the State. The results of these tests have been carefully studied in the light of all available information in regard to cultural methods, fertilizer practices and crop conditions, and data has been compared with results on soils of known fertility requirements. It is now possible to present certain interpretations of soil tests which should prove helpful to those who avail themselves of this service.

Soil Reaction

Soils may be acid (below 7 pH), neutral (7 pH) or basic (above 7 pH) in reaction. Most economic crop plants grow best at reactions between 5.8 and 7.6 pH. A slight acidity is rarely harmful, and is to be expected on the most fertile soils of this State. Medium degrees of acidity (5.0 to 5.8pH) are desirable for crops troubled with diseases which prefer a less acid condition, as in the cases of potatoes and tobacco. Such crops as corn, timothy, oats, rye and tomatoes do well at medium acidity, if other conditions of fertility are favorable. Moderate liming is necessary for more acid-sensitive crops, such as alfalfa, spinach, lettuce, etc.

Very acid soils (below 5.0 pH) require liberal liming for most crops. Strawberries, blueberries, rhododendron, laurel, and azalea may be grown best on such soils, without lime application. Extreme degrees of acidity (below 4.5 pH) usually prove harmful to such lawn grasses as bent and fescue, which do not require liming on fairly acid soils.

It must be kept in mind that there is a considerable seasonal fluctuation in acidity, and heavily fertilized soils may be as much as one pH unit lower in midsummer than in early spring or late fall. Samples taken at the latter seasons may be more satisfactorily used as an index to the true conditions of the soil.

Ammonium and Nitrate Nitrogen

Nitrogen exists in the soil largely in the form of partially decomposed organic residues containing proteins. Micro-organisms (bac-

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teria and fungi) gradually transform this nitrogen into ammonium compounds. Organic nitrogenous fertilizer materials and leguminous crop residues are thus more readily attacked, due to their high protein content. Some fertilizer materials, such as sulfate of ammonia and ammonium phosphates, add ammonium compounds directly to the soil.

Nitrogen in the form of ammonium compounds may be utilized as such by many plants, especially during their early growth period. Under normal field conditions this form of nitrogen is rapidly converted, first into nitrites, and then into nitrates, by certain species of bacteria. Hence soils rarely show high ammonia tests, unless they have been fertilized with nitrogen in this form during the past few weeks. At other times a high ammonia test is an indication of poor nitrification potentialities in the soil, as a consequence of high acidity, of poor soil aeration due to water-logging, or of some other abnormal factor.

Soils showing high ammonia tests cannot be reliably tested for potassium by the usual simple methods, due to interference of the ammonium ion in the chemical reaction.

Nitrate nitrogen, whether formed in the soil from nitrification of ammonia derived from organic residues and fertilizer materials or directly supplied in the fertilizer (as, for example, nitrate of soda), is rapidly assimilated by the roots of living plants, and is readily lost from the soil by the percolating action of heavy rains. Hence high tests for nitrate nitrogen in field soils are to be expected only when the root system of the crop is not yet fully developed.

High tests indicate a large reserve of readily available nitrogen for the use of the crop as it begins to draw heavily upon the soil. Rapidly growing annual crops require a larger reserve during the early part of their life in the soil, since the gradual processes of nitrogen liberation are rarely sufficiently rapid to meet their requirements during the period of most active growth. Crops with perennial root systems, such as sod grasses, shrubs and trees take up nitrogen through a much longer period of the year, and low nitrate tests do not necessarily indicate a lack of available nitrogen.

Low tests are to be expected at the end of the cropping period, during winter and early spring, and after a period of heavy rainfall. Under such conditions, when all other factors are favorable, the absence of nitrates may not indicate poor availability of soil nitrogen, but the crop is apt to respond to the addition of a readily available nitrogenous fertilizer.

In order to give a reliable indication of the amount of readily available nitrogen in the soil, tests may be made on samples which have been kept in "mellow moist" condition, in a loosely covered vessel at a temperature of 60° F. or above for several weeks. Low nitrate tests on such samples indicate real nitrogen deficiency in the soil.

Abnormally high nitrate nitrogen tests are occasionally encountered in greenhouse and other intensively fertilized soils, and are an indication of possible injury to the crop due to excessive concentration of the nitrate salts. Such a condition may be corrected by leaching the soils with large amounts of water.

Phosphorus

Phosphorus occurs in unfertilized soils in slowly soluble mineral and organic combinations. It is a component of all mixed fertilizers, and is frequently applied directly as superphosphate.

Under high levels of fertilization, in excess of 800 pounds per acre per year of fertilizers containing as much as 8 per cent of "phosphoric acid," crops remove less phosphorus than is applied to the soil. This element is not leached downward. In soils of only moderate degrees of acidity, applied phosphates remain for long periods in fairly available form. On highly acid soils, containing much active aluminum and iron, more difficultly soluble phosphate compounds are formed with these elements. At low rates of fertilization the phosphorus supplied by the fertilizer results in little or no accumulation, and there may be a net loss when little manure or fertilizer is used. Under such conditions Connecticut soils usually receive no lime, and a high acidity and low phosphorus availability are the rule on most areas of this type.

The phosphorus test indicates the level of more readily available phosphorus in the soil, either native or as a residue from previous applications. There are marked differences in the abilities of various crops to thrive at different degrees of phosphorus availability. Most market garden crops, potatoes, tobacco, and most legumes require the addition of phosphatic fertilizers unless high tests are obtained. Many soils showing only medium tests grow good grass hay, corn, oats and alsike clover with very little phosphorus fertilization when otherwise in a fertile state. Low or very low tests indicate the necessity for proportionally high amounts of "phosphoric acid" in the fertilizer, depending upon the crop grown.

The active phosphorus content of the soil is a fairly stable property, except as affected by recent fertilizer application. Soils which have received direct applications

of arsenical materials may give high tests, regardless of their phosphorus content; hence results in such cases are unreliable.

Potassium

Potassium occurs in soils in large amounts in the form of difficultly soluble rock minerals. Their gradual decomposition liberates small quantities of potassium which is loosely combined with colloidal material (clay and humus) capable of being displaced into the soil solution by base exchange reactions. Potassium is also added to the soil in fertilizers containing potash, or as manures or crop residues, and largely goes over into the exchangeable form. Some potassium is removed from the soil by leaching, especially when under cultivation and liberally fertilized.

The active potassium of the soil, capable of nourishing the crop, is that which exists in exchangeable form, or in true solution. This may now be readily determined by the simple soil testing method used by this Station.

Active potassium may be removed from the soil more rapidly than replenished by natural processes, thus tests may be lower at the end of the growing season of a crop with high potash requirements, than after the soil has been fallow or supporting little vegetation for several months. Hence, most reliable tests are obtained in the spring, prior to fertilization.

High potassium tests should be obtained on soils planted to vegetable crops, tobacco and potatoes. Potash fertilization cannot be omitted on such crops, at least for more than one or two seasons, even on soils showing very high potash tests, since the existing favorable conditions cannot long be maintained by natural soil processes.

Legumes and general farm crops, on soils in otherwise favorable degrees of fertility, may require little or no potash fertilization when occasional applications of manure are used, if medium or high soil tests are shown. Soils with low and very low tests usually respond to the addition of potash to the soil, either in the form of fertilizer or manure, for most crops and permanent grass sods.

Calcium

Calcium in soils occurs in the form of undecomposed carbonates (in calcareous soils), rock minerals, as exchangeable calcium (absorbed by the soil colloids), and as soluble calcium salts. Acid soils contain no carbonates, and are depleted in exchangeable calcium. However, many soils which show a considerable degree of acidity by pH tests may have a fair amount of exchangeable calcium. This is es-

pecially true of soils high in organic matter or active mineral colloids. In many cases the calcium test is a better indication of lime needs than is the pH test.

Soils with high and very high calcium tests contain adequate amounts of calcium for all crops, and usually do not respond to liming, unless a high active aluminum concentration is indicated. Medium calcium tests on soils near the neutral point may be expected on light sandy soils, but on acid soils a need for lime is revealed, for alfalfa, sweet clover, and lime-loving vegetable crops. A low calcium test on soils with a high aluminum test is a certain indication of lime requirement for all except the most acid-tolerant plants such as blueberries, strawberries, or ericaceous shrubs. When a very low test results, lime should be used in liberal amounts for most crops, unless only moderate applications may be made with safety on account of disease factors, as in the case of tobacco and potatoes.

It must be borne in mind that unless all other tests are satisfactory heavy liming may produce an abnormal soil balance. Thus liming has frequently proven injurious on many sandy soils of the south which are deficient in other elements, such as magnesium, manganese, potassium or iron.

Magnesium

Magnesium occurs in soils in the form of dolomitic carbonates, unweathered minerals, as exchangeable magnesium, absorbed by the soil colloids, and as soluble magnesium salts.

High and very high tests for magnesium are developed from calcareous soils derived from dolomitic limestones and moderately acid soils resulting from the weathering of rocks high in ferro-magnesian minerals. Medium tests are more common on soils of moderate acidity, on calcareous soils from high calcic limestones, or on soils which have been moderately limed with material of dolomitic origin. Low tests are common on acid soils. Some strongly acid soils give very low or negative tests. This is particularly true of sandy soils. In such cases magnesium should be applied. The cheapest form is in dolomitic lime or limestone. On soils giving high calcium and very low magnesium tests, magnesium sulfate (Epsom salts) is to be preferred. Commercial fertilizers are now available which supply magnesium in these forms.

Aluminum

Aluminum occurs in large amounts in all soils, in the form of undecomposed minerals and in the inorganic colloidal material. In neutral, slightly acid or slightly alkaline soils, the element is in inert combinations which

have no direct effect upon plant growth. At greater degrees of acidity, aluminum becomes active, capable of combining as soluble salts and thus exerting a toxic effect upon the growth of many plants, especially those which are benefited by liming when grown on acid soils. A high or very high test is a certain index of an undesirably acid soil, upon which acid sensitive crops are almost certain to fail. A medium test is not so serious, especially with grasses, corn, oats, potatoes, and tobacco. A low or negative test is desirable, except for distinctly acid-tolerant plants.

Manganese

Manganese occurs in small amounts in all soils, chiefly in relatively insoluble combinations. In some calcareous soils and acid soils which have been heavily limed, practically no manganese is present in active forms, and some crops are unable to obtain even the small amounts necessary to meet their requirements. Poor growth and a yellow, chlorotic condition results.

On the other hand, strongly acid soils may contain injurious concentrations of active manganese compounds. Under such conditions liming is a corrective measure.

Manganese is changed by oxidation to less active forms, or may be leached from the soil. Hence tests are of most significance when made just prior to planting or during crop growth. A negative test at such time indicates the desirability of applying manganese. Twenty-five pounds of commercial manganese sulfate per acre is usually adequate to correct any possible deficiency. It is doubtful if manganese is needed if any positive test whatsoever is developed. Medium or moderately low tests are of little significance, except as indicating no manganese deficiency. High or very high tests are undesirable, and indicate a need for lime.

Iron

Iron is an abundant constituent of all soils, existing in the form of iron oxides and many complex mineral combinations. Normally only very small amounts of iron are in active form in the ferric state of oxidation. Under conditions of high acidity, larger amounts are to be found, and under poor drainage conditions, especially in the presence of organic matter, active ferrous iron compounds are developed. Soluble ferrous salts are harmful to plant growth, and are a contributing cause to the infertility of poorly aerated soils.

The presence of very low, yet definite amounts of active iron, as revealed by the test, is desirable for all crops. Higher amounts, on well drained soils, may not be injurious to crops capable of growing under strong-

ly acid conditions. Abnormally high iron tests on poorly drained soils indicate an unfavorable condition.

Negative iron tests may occasionally result on heavily limed soils of excessive sandiness. A chlorotic condition of the leaves may develop in such cases, which is controlled by spraying the plants with iron salts. No case of this sort has been encountered in this State.

Other Tests

Occasionally soils which give poor results contain unusual or harmful concentrations of other chemical constituents. Abnormally high tests for chlorine and sodium show the presence of injurious amounts of common salt. Very high sulfate tests, on soils of unusual acidity, indicate the presence of harmful amounts of sulfuric acid. The presence of more than traces of nitrite nitrogen is likewise injurious, and is occasionally encountered on poorly aerated soils. In all questionable cases these possibilities should be fully investigated.

Other Factors Affecting Crop Growth

Soil testing to determine the nutrient conditions within the soil by means of comparatively simple tests is a comparatively new phase of soil science, and has been made possible by the rapid development in our chemical knowledge during the present century. It promises to be a valuable contribution to the more intelligent management of the soil, helping to forestall crop failure due to improper fertilization and preventing wasteful use of unnecessary fertilizer ingredients.

However, the best fertilizer and liming practices cannot overcome the injurious effects of deficient or excessive moisture conditions, poor soil tilth, weed competition, improper cultural methods, or insect and plant disease troubles. All these factors must be reasonably favorable to plant growth, else the most thoughtful care in providing favorable nutrient conditions will come to naught.

The Home Orchard

Condensed from Gardeners' Chronicle

George L. Slate

New York Agricultural Experiment Station, Geneva, N. Y.

THE amateur fruit grower who once grew a collection of choice fruits for his own enjoyment now grows Gladiolus, Iris, and what not, and considers that his sense of taste is satisfied with chemically ripened and artificially colored citrus fruits, poor quality bananas, and the few stone fruits that are profitably prolific and tough enough to be shipped long distances to market. Many of the fine old varieties, noted for their quality, are a thing of the past. Only by growing these varieties in the home orchard is one able to have them and enjoy them at their best. A judicious selection of the right varieties will provide fresh fruit from the first cherries to the late keeping apples. The labor of caring for the home orchard is not excessive, but it is essential that one know what to do and when to do it.

A suitable site has much to do with the success of the planting. A medium loam soil will do very well for all the tree fruits, but heavier and lighter soils are often satisfactory if properly managed and suitable as to drainage and organic matter content. If any choice is available, the lighter soils are preferable for peaches and the heavier types may be used for plums and pears. Soils rich in organic matter are more fertile than those not as well supplied with it. Stable manure and green manure crops may be used to improve the physical condition of the soil before the trees are set. Drainage is all important; no tree fruit will tolerate "wet feet" during the growing season. Low spots with poor air circulation are frosty and colder in Winter; fungus diseases are worse in such a location. A gentle slope is a better site. Southern slopes are earlier, which may be a disadvantage because of frost. Northern slopes are cooler and later, usually an advantage. Protection from strong winds may save the crop from blowing off.

In the matter of nursery stock, the gardener should take his cue from the commercial orchardist. With peaches and sweet cherries, the heaviest grade of one-year-old trees is probably best. The

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larger grades of two-year-old apples, pears, plums, and sour cherries are preferred, although the one-year-old trees are satisfactory. The so-called bearing-age trees are a snare and delusion. They are often the culls that remain after a block of nursery stock has been pretty well cleaned up. Moreover, these old trees get such a shock from transplanting that their future performance is unsatisfactory.

Dwarf apples are an interesting novelty for the small place, but they are shallow rooted and may blow over easily. If there is room for only a tree or two, it will be advisable to have one standard tree with several varieties grafted into it. Nursery trees with two or three varieties grafted in are now available from a few firms. Generally speaking, firms which make a specialty of fruit trees and grow their stock are to be preferred to those firms which specialize in ornamentals with fruit as a side line. Buy directly from the grower when possible.

On arrival, the bundle of nursery stock should be opened immediately and the trees examined as to condition. If the bark is bright and unshrivelled and the cambium green, the trees are in good condition and should then be heeled in in a trench in a shady spot until ready for planting. The trees are placed in the trench in a slanting position, with the soil worked tightly around the roots. They should be planted as soon as the soil can be prepared.

While planting the trees, keep the roots covered with canvas or in a mud bath. Dig a hole large enough to accommodate the roots without crowding, then pack the soil firmly about the roots by stepping heavily on it. If the soil is dry, a pail of water in the planting hole will help the tree get started. No fertilizer is used the first year.

The height of the head is established at planting time at two to three feet from the ground. All branches are removed, except three or four spaced well apart. The after pruning consists of removing any vigorous branches which may compete with the previously selected scaffold branches. Bad crotches may be eliminated by frequent cutting back of one of the two branches of equal size. Until the tree reaches bearing age, light corrective pruning is all that is needed.

Soil management in the home orchard is a relatively simple matter. Since cultivation requires tillage machinery which may not be available, the orchard may be left in sod and fertilized rather heavily so that there will be enough fertilizer for both tree and the vegetation under it. The grass may be cut once or twice

and piled around the tree under the outer branches. If desired, additional mulching material may be piled under the tree to a depth sufficient to keep down weed growth. Heavy mulching is a very satisfactory method of soil management in the orchard, and fruit trees have borne some heavy crops when mulched. The mulch also protects the drops from bruising.

Nitrate of soda or sulphate of ammonia is the only chemical fertilizer that it will be necessary to apply, except in poor soils where a complete fertilizer may be used if nitrogen alone does not result in satisfactory growth and production. A good rule for applying nitrate of soda is to use one-third of a pound for each year the tree has been set, or five pounds for a fifteen-year-old tree. Only about half as much should be applied to pear trees, as the too vigorous growth which may be stimulated will be subject to fire blight. Bearing peach, plum, and cherry trees will need about five pounds a year, possibly more for large trees. These amounts are only suggestive and may be increased or decreased, as the needs of the trees become apparent. Stable manure is excellent for fruit trees.

Young trees should be watched closely for borers near the base of the trunk and should be protected from rodents.

Varieties which are suggested for the home orchard are chosen chiefly for their dessert quality, although reliability and season of ripening are emphasized.

The earliest is Melba, a very delicate but high-flavored sort. Next in order is Early McIntosh, which needs thinning to attain good size. It is followed by Milton, which is in season until McIntosh is ready. After McIntosh is Cortland and Macoun, a most delicious sort. The old standby for the kitchen is still Rhode Island Greening. Good Fall cooking and baking apples are Fall Pippin and Twenty Ounce. A better Summer apple for cooking than Yellow Transparent is Lodi. Other high-quality apples are Gravenstein in the Fall and Northern Spy in the Winter. South of the northern tier of states, Delicious, Jonathan, Grimes Golden and Golden Delicious are good varieties and all of excellent quality. For sweet apples, Sweet Bough in the Summer and Sweet Delicious in the Fall are as good as any. A very beautiful crabapple and good ornamental is the brilliant red Dolgo.

A luscious fruit is the pear with its rich buttery flavor. Tyson, a nice mid-summer variety with a fine tree, starts the season and is followed by the well-known Bartlett which, in turn, is followed by the new Gorham, a

pear of the same general type as Bartlett. For late Fall, Seckel stands at the top of the list for quality. Next is Sheldon and for early Winter, Phelps is useful. Of about the same season is Beurre Bosc, with its high flavor, beautiful russet skin, and shapely figure. The Winter pears are not very satisfactory, but Winter Nelis is of good quality, although the tree is poor.

The best peaches are nearly all new ones, chiefly from the experiment stations of New Jersey and Ontario. Ripening in this order are Mikado, Marigold, Oriole, Golden Jubilee, Valiant, Veteran, Champion (white fleshed), Early Crawford, J. H. Hale, Elberta (not bad when tree-ripened) and Crosby. New and promising, although not well-tested, is Hale-Haven.

Sure Crop is the best nectarine, the fruit of which was once defined as "a peach with the skin you love to touch."

The commercial plums are nearly impossible for the amateur with one or two exceptions, but a few good ones are still in the trade. Few persons realize the range of flavors and the real dessert quality available in this fruit. Good European plums are Washington, Jefferson, Imperial Epineuse, Stanley, Italian Prune (for canning), and Reine Claude. Shropshire is the best Damson and makes a fine preserve. The Japanese plums are inferior in quality but very early and attractive. At the beginning of the season, a few Beauty and Abundance can be enjoyed until the European types are ready.

Sweet cherries are a real quality fruit and come in many varieties, nearly all of high quality. Seneca is first and must be netted to save it from the birds. Soon ripens Early Rivers and that old door-yard favorite, Black Tartarian. A beautiful black Bigarreau is Schmidt and with it is Emperor Francis, an improved Napoleon. Bing, Giant, Lambert, and Windsor close the season. Montmorency is the standard and best sour variety; if a later one is desired, English Morello may be planted. The Dukes combine the richness of the sweet cherry with the refreshing sprightliness of the sour cherry and are a fruit for the connoisseur. Reine Hortense and Royal Duke are two of the best. Nearly all tree fruits except the peaches need cross pollination and to provide this more than one variety of a fruit should be set.

Freedom for More Profitable Work

Condensed from The Furrow

Irvin J. Mathews

HARRY HAYWARD, a thirty-six-year-old farmer of La-Salle County, Illinois, operates 300 acres of land, sixty of which he owns. The balance he rents.

Hayward was one of the eight member farmers of the 424 in the Illinois Farm Bureau Farm Management Service who were above average in all of seven important analysis factors during 1936.

In 1935, this young farmer netted ten per cent on his investment, and in 1936, he netted nineteen per cent. And 1937 has shown an even higher return How does he do it?

Here are some of the secrets from his farm records. Of his tillable land, seventy-four per cent grew high profit crops—corn, alfalfa, sweet clover and, lastly, winter wheat as a cash crop. Hayward harvested fourteen dollars worth of feed off each acre, although the average state harvest was but eleven dollars worth of feed per tillable acre. His corn yield was forty-seven bushels per acre, in spite of the drouth. In 1937, he harvested 9,713 bushels of corn from 150 acres, or 65 bushels per acre. Also, in 1937, his 55 acres of oats made 54 bushels per acre, and his 36 acres of soy beans yielded 23 bushels per acre.

The efficiency index of all livestock on his farm was 116. This means that Hayward realized sixteen per cent more money from them than others did with similar livestock under comparable conditions. His cattle returned eleven per cent more income than similar cattle fed by others, and his hogs returned $200 worth of pork for each $100 worth of feed consumed.

Even the poultry chipped in to swell the total, and his flock of sex-linked pullets returned $316 for each $100 worth of feed put before them. And they laid twenty-five per cent of their eggs during October, November, and December, when the prices were the highest.

If you go sleuthing for the why of these unusual records, the owner will tell you it is because he made his time count in every possible way.

He accomplished twenty-two per cent more with his own time than the average farmer, and his horse and machinery costs were

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low because he uses the best of machinery, keeps it working at its maximum efficiency, covers a large number of acres with each tool, and maintains these machines at all times in excellent working condition. When they are not in use, they are stored away, with all working parts oiled.

With this background of effective work, Harry Hayward explains: "My time is all I have to put into my business. That can't be stretched much, but any farmer can command the added assistance of three mighty forces: efficient machinery, gravity, and the hidden resources beneath the topsoil which can be tapped only by such deep-rooted plants as sweet clover, alfalfa, and corn. Properly combined, they spell profit for any operator."

"One of the first things I did was to decide upon a line of machinery that I consider the most reliable, a line I can easily and quickly get repairs for. I have added to my machinery from time to time until now the farm is fully equipped. I am in partnership with my neighbors, too; I own all the hay machinery, and a neighbor owns the harvesting equipment, and we exchange. There are three of us who own the thresher and the field cutter for filling silos."

Realizing early that his time was the one big element he had to toss into the hopper, Hayward set about to make it worth the maximum amount.

He not only keeps twenty-seven head of Guernsey cattle, but he feeds out hogs of his own raising and also feeds a carload or so of beef cattle each year.

Obviously, he is not the sort who laboriously carries the cattle's corn and meal to the bunks. "Steers can do all that lugging themselves and do it better," he says. Nor does he try to balance the rations for his hogs. He puts it this way: "A hog will first eat the corn after the steers. After that, I merely put enough corn and tankage where he can get it, and he will complete the balance all by himself."

Hayward's barn houses the dairy cows and the fattening cattle; hogs are kept in a covered shed built onto the barn. This is a model of convenience. Water is always at hand, and the silo is situated where it serves both dairy and beef cattle equally well.

"Fast fattening is economical feeding," said Hayward as he showed me through this shed, pointing out the cattle self-feeder that holds 240 bushels of shelled corn and, on the other side, the hog self-feeder that holds 120 bushels of shelled corn.

"After I get the cattle on full feed," he went on, "my job is to see that my self-feeders are full and always working. Using grav-

ity in this manner liberates a lot of my time to be spent in other profitable work. The cattle and hog shed has a concrete floor. That floor cost me about $100, but it is worth it every year—there is no mud to wade around in, no feed wasted, less bedding required, and absolutely no loss of fertility. I back the manure spreader right into the lot and the manure is handled only once. It gets to the field with positively no yard losses."

The two big self-feeders are placed so they can be filled from the outside without opening a gate. The cattle self-feeder is filled by driving the wagon up outside the barn and scooping the shelled corn into it to feed down on the inside; the hog self-feeder is filled by driving the truck up outside the fence. Hayward feeds the pea-size cottonseed meal—pea-size in order to avoid waste from blowing.

"The worst of all wastes of time," Hayward maintains, "is cultivating land that doesn't produce." So, after the landlords have limed and phosphated their soils, this co-operating tenant uses a rotation that still further conserves the fertility of their soil. His rotation for these farms is corn, followed by oats seeded to sweet clover, or soy beans—a very compact rotation that recommends itself highly. It delivers fifty per cent of the land in corn each year, twenty-five per cent in oats seeded to sweet clover for fall pasture, and twenty-five per cent in soy beans. The half of the last year's cornfield that had soy beans on it this year will have oats seeded to sweet clover two years hence, and vice versa. Following this plan, it takes four years to cover all the land, and, during that time, each field has grown corn twice and sweet clover in between once and soy beans between once.

Uniform Flock

Hayward manages his poultry with the same good judgment.

"We don't fuss with raising cockerels. It doesn't pay. We dispose of the old hens, too, because I have found that I can make my time worth more by selling it to higher-producing pullets."

He put his tractor on rubber because that increases its efficiency and thus makes his own time more valuable.

"Modern machinery," according to Hayward, "has taken the drudgery out of agriculture and makes it possible for me, and a man hired for six months out of the year, to tend 300 acres easier than one man could tend forty acres twenty years ago. And, whenever a new avenue opens up for making my time worth more, naturally, I take it.

"Take the field ensilage harvester and blower, for instance. That's the method we use for fill-

ing our silos now because it takes fewer men and less time. With the cutter delivering the cut cornstalks into the wagons right in the field, and a blower at the silo, we can fill the silo now with a crew of four teams hitched to triple wagon beds, and eight men—two in the silo, one at the blower, one driving the cutter, and four bringing in the loads."

Whenever Hayward adopts an easier or quicker method of doing the same work, he looks upon that as merely the release of more of his energy to apply to other productive work. To him, as to all other efficient farmers, the clock of life is wound but once.

Fertilizers for Better Asparagus

Condensed from N. J. Farm and Garden

Robert E. Young

Agricultural Experiment Station, Waltham, Mass.

ASPARAGUS is a long-time crop, and if it is to pay the grower for his effort, particular attention must be given to selection of the proper fertilizer. Being a perennial, it cannot be changed each year from field to field to receive the benefits of crop rotation and cover crops or other organic matter that have been turned under.

As a rule the asparagus that is produced in the eastern part of the United States is grown in light, sandy soil. Asparagus seems to make better growth in such soils than when grown on good loam.

The results of experimental work lack unanimity concerning the use of manure or other organic matter. In most experiments where manure has been supplemented with commercial fertilizer, the yields have been far superior to those obtained where fertilizer alone was used. On a coarse, sandy soil the effect of seaweed as an organic material was particularly outstanding in getting the asparagus started and producing high yields early in the life of the plants. From the practical standpoint it is questionable if a grower could afford to use manure on his asparagus bed if he has to compete with general market gardeners in purchasing that manure.

The land for new asparagus

Reprinted by permission from N. J. Farm and Garden, Sea Isle City, N. J., June, 1938

beds should be well built up with cover crops or other forms of organic matter before setting the roots. When the tops of the asparagus plants are worked into the soil they supply considerable organic matter, and if every three or four years a light application of manure or other organic matter could be made this would, no doubt, prolong the life of the bed and increase the production with less damage to the plants in time of drought.

The nitrogen in the fertilizer has been shown by experiments to be important for asparagus, particularly on light, sandy soils. The form of nitrogen seems to affect the yield slightly, the organic form of nitrogen producing the largest yields but not a sufficient increase over the nitrate form to pay for the added cost of the organics. The nitrate form has given slight increases over the ammonia form in some experiments. On sandy soils and experiments in sand culture the difference has been distinctly in favor of the nitrate. No doubt the acidity of the soil is an important factor in determining the effect of the ammonia form of nitrogen on yields. In a series of experimental plots that were conducted on a coarse, sandy soil which received no lime during the experiment, most of the plants receiving sulphate of ammonia were dead by the sixth year, while the plants receiving nitrate of soda were almost equal to the plants that were kept limed to above pH 6. Where the asparagus was grown on a good loam soil, the sulphate of ammonia plots were slightly better than nitrate of soda.

Calcium cyanamid has been used by many asparagus growers, not only as a source of nitrogen and lime but as a means of controlling the small weeds during the cutting season. Probably the best method in controlling weeds is to use 300 to 350 pounds an acre applied in a band eighteen inches wide over the row at the time the first crop of weeds is two inches high. A similar application is made at the time the second crop of weeds is two inches high. This application will supply all the nitrogen necessary for good growth. A complete fertilizer cannot be used, so superphosphate and potash must be applied to make a balanced fertilizer.

The amount of nitrogen that can be profitably used depends, to some extent, on the type of soil, general level of plant growth, and the relationship to the other plant-food elements, particularly potash. The recommendations vary from 60 to 160 pounds of actual nitrogen an acre. If manure or other organic matter is used, or the crop is grown on a good loam soil, the smaller figure

is probably nearer correct, whereas if the crop is grown on a sandy soil, poor in organic matter, a larger amount will be necessary for large yields.

The form of phosphorus used for asparagus has not been the object of very many experiments, probably because superphosphate is the one generally used. The value of phosphorus for asparagus has been questioned by many growers who claim that it causes the tips to spread prematurely. In all the experiments conducted in Massachusetts an ample supply of phosphorus increased the yield, and in recent experiments where a careful check was made there was no difference in the spreading of the tips on the plots receiving no phosphorus and those receiving a generous supply.

In all the experiments mentioned before, greater response to potash has been obtained than for either nitrogen or phosphorus. These experiments indicate that potash is the most important fertilizer material for asparagus. The results of recent experiments show that the yields of asparagus were increased with each increase up to 360 pounds of actual potash an acre, which would be 720 pounds of fifty per cent muriate of potash. Of course, it is questionable if the larger amounts of potash can be used economically. It has been found that where the larger amounts of potash were used the yields could be further increased by applying a larger amount of nitrogen, thus pointing to a nitrogen-potash relationship. On a coarse, sandy soil when potash was omitted from the fertilizer the yields were very low. If only a small amount of money can be spent for fertilizer, it is probable that most of this should go for potash.

The kind of potash to use seems to be of major importance, with experimental data showing the muriate form to be the best and not much difference between the nitrate and sulphate forms. The extra value of the muriate form of potash may be due to the sodium chloride or salt it contains, although salt when applied directly has failed to show such differences in yield as those among the three forms of potash.

There seems to be considerable variation in the results of experiments designed to determine the proper time for applying fertilizer. Considering all the data, it does not seem to make much difference when the fertilizer is applied as long as the application is not delayed beyond the time of the last cutting.

The result of one experiment conducted in Massachusetts indicated that it was slightly better to apply the phosphorus early in the spring before the cutting season. It is probable that this early

application permits the phosphorus to be more thoroughly worked into the soil by the cultivations made during the cutting season. Where mixed fertilizers are to be applied it is questionable how many growers would care to divide this application, thus making double the work. If fertilizer materials are to be used it is probably best to apply the superphosphate and potash before the asparagus bed is prepared in the spring, thus affording ample opportunity to work these materials well into the soil. The application of nitrogen fertilizer can then be divided as the grower desires. All the fertilizer should be applied to the bed by the end of the cutting season.

Recommendations on Sandy Soil

Where good growth is obtained use one of the following:

1. Apply 1,500 to 2,000 pounds of an 8-10-12 or similar analysis fertilizer an acre, apportioning the quantity if desired, applying two-thirds of the fertilizer before the cutting season. If no such analysis as 8-10-12, 4-5-6 or 5-8-10 fertilizer is available, use 5-8-7 and apply 200 pounds of muriate of potash or nitrate of potash in addition.

2. Apply 1,200 pounds of superphosphate and 400 to 500 pounds of muriate of potash an acre before preparation of the bed in the spring. Top-dress with 125 to 160 pounds of actual nitrogen an acre, using either 600 to 800 pounds of cyanamid or 800 to 1,000 pounds of nitrate of soda. If cyanamid is used, apply in two equal parts, the first at the time the first weed crop is two inches high. The fertilizer should be used over the row only, a band of eighteen inches wide being sufficient. This application will control most weeds for about two weeks. The second application should be made at the time the next crop of weeds reaches one to two inches in height. If nitrate of soda is used to supply the nitrogen, one-half should be applied before and the remainder at the conclusion of the cutting season.

Grass—Guardian of Soil

Condensed from The Nebraska Farmer

D. L. Gross and Carlyle Hodgkin

THE *above-ground* importance of grass is no new story. Everybody is interested in better pastures; everybody knows that good grass is, in fact, the real mother of livestock farming. But few persons are as fully aware of the *underground* importance of grass.

Grass does three important things to the soil.

First, it binds the soil together with a mass of strong, fibrous roots. Second, it granulates the soil, giving to it a porous structure that greatly increases its water-holding capacity. Third, it protects the soil surface with a mantle of decaying vegetable materials. Consider these three things in order.

1. Binder and Sponge

The roots of the perennial grasses are abundant and strong, much stronger than the roots of the legumes or the annual crops. They fill the soil full of living fibrous material that binds it together as hair binds plaster and iron rods bind concrete. This tough root material also decays slowly; and the end product of its decomposition is an abundance of humus, which absorbs and holds water like a sponge.

Soil studies have shown that live grass roots in the soil may amount to as much as 10 tons per acre. The quantity of both live and dead plant material in our native sod has been estimated at as much as 100 tons per acre. It is upon this tough, slowly decomposing, nitrogen-giving, erosion-resisting, water-holding root material that the productivity of our soil rests.

Farmers have been growing alfalfa and clover to add nitrogen to the soil. These legumes are highly important for the maintenance of soil fertility, but their roots are not like grass roots. They are soft; they decompose rapidly, leaving the soil in an ashy condition. Dr. J. E. Weaver, of the University of Nebraska, has found in the top 4 inches of big bluestem sod, 8,340 pounds of live root material per acre; in the top 4 inches of alfalfa sod he found 3,528 pounds of both fibrous and tap root material, and only 522 pounds of this was of fibrous, soil-binding character.

Dr. Weaver studied this point by producing rain (from a spray nozzle) on one-half square meter

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of sod of different kinds. He found that it took 3 hours, 28 minutes to erode away the top 4 inches of big bluestem sod, 21 minutes to erode away the top 4 inches of 4-year-old alfalfa sod, and 15 minutes to erode away the top 4 inches of second-year sweet clover sod.

2. Water Into Soil

Under grass the soil takes on a granular character; it doesn't lie there in one solid impervious chunk; it cleaves together in an infinte number of crumb-like particles that water can pass between. And it contains countless tiny chambers formed by grass roots that have decayed. Water goes down into a solid, rootless soil slowly, by capillary action. Water goes down into a root-filled grass sod rapidly.

Dr. Weaver's experiments on this point are striking. He sprayed 2½ inches of water on prairie grass 3½ inches high for 3 hours. The percentage of run-off was zero. He sprayed the same amount on thin bluegrass pasture in the same time and 28 percent ran off. He sprayed the same amount on bare ground (weeds removed) and 50 percent ran off.

In another test he sprayed 3 inches of water on a 10-percent slope at the rate of 1 inch each half hour. The table shows what happened:

Water Applied	Percent Runoff		
	Prairie	Pasture	Bare Area
First Inch	14.6	45.0	63.2
Second Inch	12.0	52.8	74.0
Third Inch	7.4	53.6	77.6

On the prairie sod actually less of the third inch than of the first ran off. Dr. Weaver cannot explain that fully. Obviously, if you kept pouring water onto the prairie, sooner or later an increasing percentage of it would have to run off. But the striking fact about this experiment is that an average of only 11.3 percent of the 3-inch rain ran off the prairie sod, while an average of 50.3 percent ran off the thin pasture and an average of 70.7 percent ran off the bare ground.

This function of grass—to increase the water-absorbing capacity of the soil—is even more important than its function as a soil binder.

3. Mat on Surface

The third thing that grass does for the soil is not strictly *underground*. It is just at the surface, but it is nonetheless important. Where there is grass the surface soil is protected by a mat of leaves and stems. This covering protects the soil particles from high winds; it breaks the grinding, churning action of driving rain; it retards the movement of water down the hillsides, thus giving it more opportunity to go into the soil.

Grazing Crops for Poultry

Condensed from American Poultry Journal

Emil G. Glaser

WHEN speaking of grazing crops, one naturally thinks of cattle and sheep, but weight for weight, chickens eat just as much green feed, or grazing crops, as do cattle. No problem connected with poultry raising is more important than that of constantly supplying adequate amounts of green feed throughout as large a portion of the year as possible.

Green feed supplies proteins, minerals, and vitamins, and in addition adds bulk to the feed, a factor which is highly essential in efficient digestion.

Grazing crops for poultry must be adapted both to soil conditions and climatic conditions. It is also necessary to consider crops which are seasonally adapted to fall, winter, spring, and summer.

The grazing crop must be tender. It must be succulent. It must be low in fiber and easily digested by the birds. It must also meet all grazing requirements over the greatest period of time. It must be drought-resistant in some areas. It must be economical to produce.

In the temperate regions where winters do not become too cold, the best late fall and winter grazing crops are Italian rye grass, crimson clover, abruzzi rye, oats and barley, wheat, and rape. These crops along with alfalfa, permanent grass sod, lespedeza, cowpeas and soybeans make good late summer and early fall green crops. Sometimes, if the winter is very open in the northern areas, winter wheat, barley, rye, and rape may be used to supply green feed most of the time. This is not to be depended upon, however.

Italian rye grass, more of an eastern crop or where the climate is fairly moist all the time, remains green and continues to grow throughout the winter. It is not injured by weather as low as zero; therefore may be grown quite far north. It does best in light soils. Its nature is such that it requires rich soil, which makes it ideal for chickens to run on, as droppings from them help greatly to keep it in a rejuvenated state. Seeding for the winter crop is done in September or October at the rate of 40 lbs. per acre, and it pays to seed liberally. It may be grazed closely and yet be unharmed when plenty of rainfall

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occurs. It contains many of the essential vitamins and has an excellent nutritive ratio for poultry. An acre will supply green feed for 100 grown hens constantly when the area is divided into two half acre plots and one grazed at a time.

Crimson clover can be grown almost anywhere as long as the soil contains sufficient lime. Other than this, it has no soil preferences. If sown late in September in southern areas, it will provide green feed all winter. In northern areas, it may be sown in the spring to have green feed all summer and fall. It is sown at the rate of 20 to 25 lbs. per acre. It is profusely leafed and chickens seem to like it better than alfalfa; they can get green feed off of it even after it has gone to seed. However, if eaten in large amounts, it will cause dark yolks.

There is hardly a section of the country where some one of the small grains will not be suited for use as a green crop for chickens. While they do not last as long due to their fast growth and tendency to become hard and fibrous, nevertheless, as temporary spring, fall, and winter grazing crops they are hard to beat.

Oats are the first choice of poultry raisers, and barley is a close second. In southern areas, oats or barley may be seeded during September and be depended upon to supply green feed for 6 to 8 weeks. These grains serve well as supplements for the Italian rye grass, as either can be grazed when the rye grass gets short. To provide early greens in northern areas, these grains should be sown as soon as the soil permits. If kept fairly well grazed, tender sprouts may be had until late in May or early June, when it is safe to sow sudan grass.

Abruzzi rye is an excellent fall grazing crop and grows more rapidly than either oats or barley. It supplies green feed abundantly, and because of its hardiness, stands ordinary winter weather well.

Wheat is an excellent fall and winter grazing crop for chickens, and as such it serves well early in the spring also if not sown so early in the fall that it stools. Winter wheat is considered the most advisable, although spring wheat will supply from 4 to 8 weeks' grazing in the spring if planted before March 1.

As all small grain crops rapidly become fibrous after having started to stool, it is advisable to have supplementary green crops to take their place.

Rape is greatly relished by chickens as long as the leaves remain tender. It needs a fertile soil and plenty of moisture to be of the greatest value, as slow growth produces tough leaves. It is seeded in late summer or early

spring at the rate of 8 lbs. per acre, and it lends itself well to late fall and spring grazing.

However, it has a short grazing period, and is not widely used by poultrymen for laying hens because it imparts an objectionable taste to eggs.

During very cold and stormy weather when the flock cannot be kept on range, it is advisable to have other green feed available. Also some poultrymen abandon the range idea of providing green feed in summer. They provide it in the form of germinated oats which may be germinated in a basement, and fed with a wet mash or alone twice daily. The sprouts are allowed to become an inch to an inch and a half long before feeding.

Dry weather in many sections in July and August and the tendency for most vegetation to become tough at this time make it difficult to supply green food.

Alfalfa and sudan grass offer the best possibilities for such conditions. Alfalfa's knack of starting all over again as soon as the older stems toughen and are cut assures an ample supply of nutritious green feed which the chickens can easily pick off. Alfalfa ranged layers should not receive so much corn in their rations as normally in order to keep the egg yolks reasonably light.

Other grasses which may be used are Kentucky blue grass where it is acclimated and not too dry (east of the Mississippi), and orchard grass, a temperate climate grass that starts very early in the spring. One middle western poultryman gets all the green feed he needs throughout the summer by picking up the mowing from city lawns.

Grass mixtures serve well in many areas where it is not too dry. Thus in the East, the mixture comprising Kentucky blue grass 5 lbs., orchard grass 10 lbs., red top 8 lbs., white clover 4 lbs., and alsike 4 lbs., makes an excellent poultry range crop. Another mixture consists of orchard grass 10 lbs., red top 10 lbs., white clover 5 lbs., and lespedeza 10 lbs. Both make excellent combinations.

Cowpeas and soybeans are excellent for following rye grass. Where alfalfa is not available, these crops serve well. In the fall, these may be turned over and followed again by rye grass.

A good arrangement for poultry grazing is to divide the range into three equal parts. If an acre is allowed for 100 hens, it may be divided into ranges A, B and C. In range A rye grass is sown; in range B more rye grass is sown. Crimson clover or some other grain crops may also be used. Range C is sown to alfalfa or a permanent grass and a legume mixture. When the crops in A and B are big enough for graz-

ing, the birds are alternated between these two until the crops are grazed too closely for any further value. This will usually last until late into the spring.

After the crops are grazed as long as satisfactory green stuff is to be had, the birds are transferred to the permanent range, which is used only as long as ranges A and B are unavailable. In the meantime, sudan grass is sown in lots A and B. As soon as it is large enough, the birds are again alternated between them, and allowed on the permanent alfalfa range only when too close grazing threatens the sudan grass. Some poultrymen may wish to sow wheat or rye on ranges A and B late in September. The alfalfa range can again be used until the wheat or rye is ready. Doing this provides a winter green crop in areas which are not too far north. Any alfalfa that gets too long in range C may be cut and used during the winter, either ground or in racks.

Plowing Pasture Furrows

Condensed from The Missouri Ruralist

NOT long ago a young man came to the Missouri College of Agriculture to take his master's degree in agricultural engineering. A major part of his "thesis" was the designing of a plow. It had to be a plow that would make a contour furrow, yet not turn the sod upside down.

This explains why Xzin McNeal got busy with a pair of left-handed and right-handed plows, a single disk and a couple of old drums from a house-mover's tackle—from which emerged a machine that lifts the sod, holds it up while the disk turns a furrow, lets the sod fall back with its grass side up, and then rolls it down to fit snugly in the bottom as well as on the sides of the new furrow terrace.

The need for such a plow has been evident since contour furrows were first attempted. Mr. McNeal, in his interviews with Missouri farmers, found they generally liked pasture furrows. He found furrows were saving about 24 per cent of the total rainfall which otherwise would run off the pastures. This moisture not only was making more grass, but soil was being held.

But while contour furrows are easily made with any kind of turning plow, no one relished having the sod turned over, leav-

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April 2, 1938

ing a bare strip difficult to reseed, which usually grew up in weeds. To make the furrows without killing the sod should remove one of the biggest objections to more furrowing, and here is the machine designed to do it. To make the machine handier, it is reversible, and light enough to pull with a 2-plow tractor or the equivalent in horse or mule power.

Mr. McNeal's plow consists, essentially, of an 18-inch tractor sulky equipped with both a right-hand bottom and a left-hand bottom to form a large lister. The upper parts of the frogs are cut away and the rear parts of the moldboards are cut off. The curvature of the moldboards also is reduced considerably so as to lift the furrow slice more gently and to avoid inverting the slices. Long, gently-curved steel slats are fastened to the rear of the moldboards to hold the sod up, while a disk, fastened immediately behind and under the moldboards, moves soil from under the upper furrow slice and throws it beneath the lower furrow slice to form a ridge.

The machine is made reversible by mounting the disk on a short beam which can be swung from side to side about a pivot point at the rear of the plow beams. The disk is mounted with the plane of the cutting edge making an angle of 28 degrees with the vertical, and an angle of 50 degrees with the forward line of travel. Adjustment of the disk beam enables the disk to be set to cut from 5 to 7 inches below the bottom of the furrow made by the lister.

A large serrated rolling coulter has been found to be of great advantage in cutting the sod and weeds and in giving a uniform furrow slice with which to form the ridge. A pair of cast iron rollers is used to bring the sod in closer contact with the new surface upon which it rests, these rollers being trailed behind the plow by a pipe hitch.

The lister has been run 5 inches deep in plowing tests, with the disk cutting 6 inches deeper into the subsoil. The disk penetrates and operates quite satisfactorily, even in hard, dry subsoil.

Although this machine will operate either in bare ground or in good sod, the latter of course, affords the better chance for smooth operation. In good sod the machine has consistently built ridges which have been an effective height of 6 inches and which are 9 inches higher than the bottom of the furrow after the sod strip has fallen in. Mr. McNeal says that with a vertical interval of .6 foot between furrows, these contour furrows will impound the heaviest rain which may be expected once in 10 years.

To make the furrows most effective and to save repair work in the event the water breaks over, the furrows should be "blocked off" at short intervals, from 25 to 50 feet. This blocking off consists merely of raising the sod at these intervals and throwing a few shovels of dirt underneath. This holds the water in the furrow between "blocks" so that if the water breaks over not more than 25 to 50 feet of furrow will be drained.

While this plow is not being manufactured, yet anyone is welcome to use the idea in making one. The cost will not be excessive, either for communities, county Farm Bureaus or other Soil Conservation organizations. Considerating all costs of work, which is mainly labor, these contour plows can be made for a cost that averaged 82 cents an acre on 32 farms in Missouri last year.

Cold Storage Lockers

Condensed from Capper's Farmer

George A. Montgomery

FOOD preservation by freezing has reached the farm. Locker plants where meat, vegetables and fruits may be frozen and held at low temperatures until needed for consumption are increasing so rapidly in the Middle West that nobody knows how many there are. The first two plants in Minnesota opened in 1935. Six more were established the next year. But that was only a start; 30 new ones began business or let contracts for construction in the first half of 1937. The start was somewhat earlier in Iowa and it is estimated there are more than 200 now. The number is growing monthly.

There is little variation in plant arrangement and equipment. Each has a front office, a completely equipped butcher shop with a trained butcher in charge, a cooling room where meat is hung to chill, a quick-freeze room where products may be frozen solid in below-zero temperatures, and a locker room where the frozen foods may be stored for customers at 15 to 20 degrees Fahrenheit. A few have abattoirs, but in most cases the plant butcher goes to the farm, dresses a carcass and hauls the meat to the plant in a small truck.

Type of ownership varies. In one town the service may be provided by a co-operative creamery

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for its customers; in another an individual or a partnership may operate a plant as an independent business enterprise; in a third a farm group may establish and manage one on a co-operative basis.

Experience in Lee County, Illinois, is typical of what has been happening in dozens of farm communities. As soon as farmers there heard of the idea a committee was sent to Iowa to learn more about it. A plant was built. Within nine months all the space had been taken and there was demand for systems in two other sections of the county.

Butchering, formerly a winter occupation largely, now continues thruout the year on farms of locker holders in areas where farm cold storage systems have been established. Very largely it has ceased to be a task for the farmer, for 90 to 98 per cent of the animals slaughtered for those who freeze meat in the various communities investigated are killed and dressed by plant butchers.

Women in Lee County who formerly canned fruits and vegetables grown on the farm began packing them in glass jars and storing them at freezing temperatures when the lockers came. Locker managers generally require that glass cans be used, and many towns with new plants have run out of jars the first year because dozens of women who never had canned vegetables decided to preserve them frozen.

Dealers in electric and oil burning refrigerators in many areas also have been taken by surprise. The cold storage locker and the mechanical refrigerator go hand in hand. Types having large compartments just beneath the freezing units to hold meats below 32 degrees have had heaviest sales. A large meat tray permits the locker customer to take home a week's supply on Saturday night and keep it in as good condition as if left in the locker. Pieces are taken from the tray in advance for slow thawing in other parts of the refrigerator.

Yearly rental for a locker that will hold about 200 pounds of meat varied from $6 to $12.50 a year for the plants visited. Managers generally require at least one locker to be rented on a yearly basis. One, with 755 lockers, had 575 rented by the year, and many of the customers, especially those who butchered both pork and beef, rented two to three extra by the month and gave them up when they were emptied.

There was less variation in charges for other services. The following typical service charges are:

Picked up and slaughtered: Beef, $2.50; hogs to 300 pounds, calves to 250 pounds and lambs, $1.50. Extra charge for hogs over

300 pounds, 25 cents for each 50 pounds.

Slaughtered only: Beef, $1.50; hog, $1; calves and lambs, 75 cents.

Cutting and wrapping, dressed weight: Beef over 400 pounds, $2.50; under 400 pounds, $2; hog or calf, $1; lamb, 75 cents.

Dressing poultry: Chicken, 4 cents; duck or turkey, 10 cents; goose, 12 cents.

Drawing poultry: Chicken or duck, 4 cents; turkey, 5 cents; goose, 2 cents.

Cooling, wrapping, freezing: Chicken, 2 cents; duck, 3 cents; turkey or goose, 5 cents.

Typical charges by the pound for various services: Grinding hamburger or sausage, 1 cent; grinding and seasoning, 2½ cents; rendering lard, 2½ cents; curing ham or bacon, 3 cents; smoking, 1 cent; freezing fruits or vegetables, 1 cent.

The farmer who butchers a large beef frequently asks the plant manager to find buyers for two or three quarters. When there is a demand from locker holders for meat in excess of the amount thus offered for sale, the plant may buy an animal, kill it and sell the meat at enough above cost to pay for butchering and cutting. In many cases, two to four neighbors agree to take turns butchering and to divide the meat. That gives them fresh meat all the time, yet necessitates but one locker apiece.

Users estimate that lockers save them 5 to 8 cents a pound on beef. The main saving on pork was in loss avoided.

In addition there are emergency savings. On a hot day last summer a fat steer slipped thru a Minnesota farm gate, ran on the road and a truck bumper severed a tendon. The owner bled the animal and called the plant butcher.

Broilers were low and grain high early last summer. Many a locker customer dressed 40 to 50 as soon as they were large enough and insured the family fried chicken in winter months. They were worth more in the skillet than on the market, but there was no use to put expensive feed into them after they reached frying size.

The principal disadvantage of this method of food storage is the inconvenience of going to town to get food from the lockers, but plant managers are making this as easy as possible by opening between 6 and 7 o'clock in the morning and closing at 7 or later in the evening on week days and at 9 on Saturay. Most places are open until noon Sunday. As a rule the manager and the butcher take turns on duty to shorten their working hours.

Creating a Soil Reserve for the Orchard

Condensed from The Rural New-Yorker

C. W. Ellenwood

IT used to be the plan to set a fruit tree and forget it until it came into bearing. As the business of growing fruit trees has passed more and more into the hands of the commercial orchardist it is generally recognized that the length and efficiency of the productive life of the orchard is dependent in a large measure on the soil treatment it receives in the pre-bearing stages of development.

It is not my purpose to set forth any best plan of treatment for the young orchard, but rather to discuss several possible plans. I want most of all to urge the need for setting up some plan of soil management in the early life of the orchard, and then making sure that the plan is followed. It may be necessary for any one of several reasons to make radical changes in the soil management during the pre-bearing stages. Shifting from a cover crop to a sod type of management or vice versa often may be necessary, and sometimes desirable. The thing to keep in mind all the time is that during these early years you are making deposits against the drain of future years when expending top and root area will make it next to impossible to add anything to the reservoir. In fact the problem then is to maintain soil fertility and water-holding capacity.

Until comparatively recent years experimental work on orchard soils was confined pretty largely to comparisons of fertilizers, cover crops and mulches and the responses to the various treatments were measured by yields or twig growth. Not a great deal was done to ascertain the effect of treatments on the physical or chemical condition of the soil. Now more bulletins are coming from the agricultural colleges on what goes on beneath the soil in an orchard. The grower is interested in the best possible soil management consistent with good economy.

It is well to understand that no manipulation of orchard soil, however good, will compensate for a naturally poor site. No soil treatment within the bounds of good economy will change a shallow soil to a deep one. A soil where tree roots extend downward 18 inches to two feet is essentially different from one which

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permits the roots to go down six to eight feet and deeper. These two types of orchard location always remain different, calling for different systems of management.

Some orchards carry an impossible handicap for this reason alone. The orchardist should always remember that by and large his treatment of the soil subsequent to planting the trees influences the soil only in a rather shallow zone. The use of deep tillage tools and tile drainage may serve to modify this statement, but in the main, after the orchard is located, the fruit-grower will be working with the first 12 to 15 inches of the soil.

Drought conditions during several seasons in the past decade have focused attention on the matter of moisture conservation in the orchard. Most of the men engaged in orchard soil work now consider the chief function of organic matter to be in the conservation of moisture and incidentally as a means of aerating the soil. Another important function of organic matter is to make available soil nutrients to the plant. A few years ago it was a common notion that cover crops were turned into the soil or mulch applied to the surface to add nitrogen and other elements to the soil. Nitrogen can be purchased now as chemical fertilizer much more economically than it can be introduced into the soil by cover crops. While it cannot be said that this matter of building up the organic content is entirely separate from fertilization, it will be best if the grower in his thinking separates organic matter from fertilization.

There are two general systems of orchard soil management now suggested: (1) A cover crop system wherein one or two crops are turned under each year, and (2) a sod cover of some sort. Care must be used in bearing orchards to follow a system that does not involve the use of a cover crop which will compete for moisture with the ripening fruit.

In a young orchard where the main objective is the accumulation of a large quantity of organic matter, such crops as sudan grass (25 to 30 pounds of seed per acre), millet (40 to 50 pounds per acre), as well as the more commonly recommended soybeans (1½ to two bushels) or a combination of soy beans (one bushel) and millet (15 pounds) may be used. Cultivation increases the possibility of erosion and tends to deplete the soil of organic matter, so theoretically at least the period of cultivation from the time the ground is disked in the Spring until again seeded, should be as brief as possible. Incidentally, a system which involves disking rather than plowing is more economical

and on the whole more satisfactory.

Buckwheat seeded at the rate of six pecks per acre is a satisfactory late Summer cover crop for young orchards. It does not provide as great a bulk of matter to turn under but if left standing until the seed ripens it will reseed itself the next season or even for two succeeding years.

The cover crop system of soil management in the growing orchard necessitates the use of some Winter cover. The most common Winter cover is rye (8 to 10 pecks per acre). Wheat is also good but provides less tonnage per acre. Wherever vetch will grow, vetch alone or a combination of rye (five to six pecks) and vetch (15 to 20 pounds per acre) makes an excellent Winter cover. Sweet clover, alfalfa and the clovers are also available as annual cover crops for young orchards where the soil reaction permits these crops to grow successfully. Most of these crops are, however, associated with the sod or an intermediate system of soil management which is part cover crop and part sod.

Before discussing sod cover of various sorts it may be well to suggest a changing from the cover crop system to one of sod. One of the most successful methods of seeding an orchard for Northern Ohio has been found to start with a seeding of rye at the regular time in early September or early October. Timothy is seeded with the rye. The following Spring a mixture of clovers is seeded. One of the mixtures frequently used contains four pounds red clover, four of alfalfa and two of alsike. The rye is clipped with a mower about the middle of May and again a month or six weeks later. If there is a normal amount of rainfall a heavy growth of clover may be expected, which will necessitate clipping by late August or early September. This plan not only enables one to shift from a cover crop to a sod system in a short time and with little danger of loss from erosion, but has the advantage of providing a considerable amount of mulch, either to be raked and scattered around the trees or left where it falls to mulch the entire area. This works well on orchards less than 8 to 10 years old. By the time the trees have reached 12 to 15 years, shading and competition for moisture by the trees has materially lessened the area where any sort of a cover crop can be grown. Even the possibility of producing mulching material from grasses or clovers in the orchard has been greatly reduced by this time. The job at this stage is to conserve or maintain soil fertility and organic matter rather than improve it.

The tendency is to develop orchards from the start in some

sort of a sod cover. The advantages are quite generally recognized. First, the moisture is conserved under this soil treatment better than under any type of cultivation. Then sprayers and other implements are moved about the sod orchard with greater ease than in cultivated orchards.

After the ground has been carefully fitted the following mixture of grasses and clovers is seeded: four pounds red clover, two pounds alsike, four pounds alfalfa and four pounds timothy per acre. Sometimes three or four pounds of bluegrass is also added. This mixture seeded at the time indicated will provide a good ground cover by the first of November. While the clovers used in the mixture are more or less temporary, the alfalfa will persist many years.

The great objection to the sod system is that it leads to neglect. The regular annual application of nitrogen fertilizer is advisable whether a cover crop or sod system is followed, but it is more necessary in the case of the sod system.

Naturally a judicious use of the cover crop system enables a grower to build up a soil during the early years of the orchard much better than the sod. If one starts the orchard on fertile soil, he can use either system. If the soil is low in organic matter cover cropping for at least six or eight years would seem advisable if the land is nearly level. On hilly land there is of course no choice but the sod system.

There is no better way to maintain soil moisture than by mulching. But mulch material is scarce. The use of the clippings in sod orchards as a mulch around the trees can be suggested for the first few years if the soil is already fertile.

Application of 250 to 300 pounds per acre of 2-12-6 or 2-14-4 fertilizer over the entire area of the orchard can be suggested for sod orchards once in every three or four years. This fertilizer also can be recommended previous to seeding an orchard to grass. Nitrogen is the only element that has consistently been beneficial. This is true even where the experiments have run over a long period of years. The standard practice is to use about one-fourth pound for each year of the tree's age of some quickly available nitrogen fertilizer carrying about 20 to 22 percent of nitrogen, or the equivalent of one carrying a lower nitrogen content. In spite of the fact that the use of phosphorus and potassium have not generally demonstrated their value in orchard fertilizers, there is a feeling among horticulturists that an occasional application of a fertilizer carrying both these elements is a good soil prac-

tice. The difficulty in the case of sod orchards is to get these elements down into the soil where they will be available for the roots, because unlike the usual nitrogen fertilizers they move down very slowly. Their value is more easily discernible in the growth of vegetation in the orchard than in tree growth.

The recent introduction of the heavy harrow, sometimes called a weed hog, has given the fruitgrower a tool he can use to break up a sod without entirely destroying it. Then there is the deep tillage tool more useful for soil aeration and breaking thru stiff sub-soils. The important thing in deciding upon any soil management for a young growing orchard is to understand the objectives and then to do the best to bring the trees into bearing as early as possible, but what is more important is to develop a soil condition that will give consideration to the long pull of heavy crops and occasionally unseasonable years.

Four Shoulders to the Wheel

Condensed from Successful Farming

Everett Griffin

A father-and-son management partnership may be worked out on a strictly business basis.

Farmers and extension workers are studying father-and-son partnerships today, for it is this type of management which is building toward rural stability. Particularly interested is Professor E. B. Hill, of Michigan State College, whose work and hobby is partnership farming.

Over the past few years, Professor Hill has studied 30 to 40 farms under the new-type management. He says that two working together can naturally do and achieve more than single individuals. Of course, there are many things to be considered before a partnership is entered into. Some of the important items are the son's age, the living arrangements, the financial situation, and the complications arising when there is more than one son to the limited home acreage. Some fathers say that a partnership may be entered into as soon as the son shows interest in farming; others prefer to wait until the son is devoted to the full-time business.

Whatever the age or experience of the son may be, three horse-

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sense provisions are essential at the very start to any father-and-son partnership: (1) There should be adequate farm records so that either Dad or Son may see where he stands at any time. (2) There should be a complete inventory made of all farm equipment and property at the beginning of the agreement. (3) The agreement should, of course, be in writing and cover at least one full farming year.

Professor Hill has worked out an almost foolproof agreement form. Of course, these provisions won't suit every farm or every farmer; but the general pattern is sound.

Under this farm-tested arrangement the father agrees to furnish land and improvements, and the materials and any skilled labor necessary for the repair and construction of buildings and improvements. In other words, since the land belongs to Dad, permanent improvements on it belong to him also—although Son has their use. Dad also agreed to furnish one-half of the investment in: machinery, horses, productive livestock, feed, growing crops, and supplies. All taxes and insurance on his property are made his concern. He shoulders, likewise, two-thirds of the expense of the following: feed purchases, feed-grinding, threshing fertilizer, and other crop expense, livestock expense and service fees, and other miscellaneous farm expenses. One-half of the expense of the following is his share: operating cost of all machinery, farm share of auto expense, livestock purchases, hired labor, and miscellaneous—such as telephone, farm-paper subscriptions, electric bill, and so on. It is agreed that Dad shall pay all the rent for additional cropland.

Son, of course, must pay all taxes and insurance on his own property, must bear his proportion of the expense listed above, and should pay a fixed sum for board, room, and washing each month if he is living under the old home roof.

Now who gets what in the matter of income? (Keep in mind here the two-thirds and one-half provisions of Dad's bills as outlined above.) "The father shall receive two-thirds and the son one-third of the following products of the year: dairy products, eggs, wool, veal, hogs, lambs, chickens, foals, and crops. The increase in the value of young stock shall also be divided on a two-thirds and one-third basis. *Any young stock, such as pullets, lambs, gilts, heifers, and foals, which may be added to the mature flocks and herds should go in on a* 50-50 *basis.* Thus, at the termination of the agreement, the son would be required to pay to the father one-sixth of the

value of young mature stock, value of young stock so retained. Receipts from the sale or increase in the value of matured stock, such as foundation stock, owned on a 50-50 basis shall be shared equally. . . ."

Dad and his younger partner should also split the income from miscellaneous receipts, such as from custom work with machinery, machinery rent, sale of machinery, refund from gas tax, and so on.

In case the son lives at home and pays for his board, a good provision might be for him to receive in cash or its equivalent, a sum equal to one-third the value of the farm produce used by the family.

Naturally, working along shoulder to shoulder in this kind of setup, Dad and Company have to agree on the time and place at which the farm products are to be sold—and on the bank through which the financial transactions are to be made. Each member of the partnership must agree to put in about the same amount of time on the farm, too, and to hire his share of the work done in case of sickness or forced absence.

There are a lot of angles to this partnership business—there are to any business, and some debates may arise. Professor Hill has a solution for this: In case of serious dispute, the makers of the lease agree to submit the problem to a board of three men, one to be chosen by Dad, one by Son, and the third by the two parties chosen. Decisions by these judges are to be the last word.

Hill thinks that one of the greatest complications to partnership farming may be encountered where there is more than one son to be considered. However, that even this situation may be pleasantly profitable is proved by experience.

Many of the partnerships come to grief. Good farms are hard to get; good city jobs are nearly impossible without hard years of apprenticeship—and the smart son figures his bread is buttered on the partnership side. As Wallace Clark said in a letter to us: "Father-and-son partnership places the emphasis on farming as a method of living, as against the commercialism involved in the hired-labor proposition."

Plant Chemistry and the Farmer

Vern A. Molstad

University of Minnesota

Winner of Prize Essay Contest, Class A

AN agricultural chemist recently visited a farmer for the purpose of making a soil analysis of his farm. During the course of the visit, the farmer, who had read a recent article on how chemistry might seriously endanger agriculture, engaged the chemist in a vociferous conversation. After the farmer had made many stinging statements, the chemist answered:

"On the contrary, we are friends. Your future is my future, and what I might do is for your betterment." The chemist told the farmer what has been done for making his farm a more profitable enterprise. He spent a considerably longer time telling the farmer about the future of agriculture and the many bright prospects it holds.

How and by what means is agriculture going to be improved? Discovery of new uses for farm products and the subsequent enlargement and extension of markets is probably the most important factor in according security to the farmer of the future. Let us look into the possibilities that the fuel (oil) market holds for the agriculturist. "In the opinion of the Bureau of Mines expert, Dr. Arno C. Fieldner, 'The Nation's proved oil supply can be depended on for only the next fifteen years.' ". Extensive research is being conducted at the present time relative to finding a suitable substitute for oil from farm crops. A manufacturing plant at Atchison, Kansas, which was established for the production of power alcohol from farm crops, has been in operation for more than a year. Should a satisfactory fuel substitute for oil be successfully and economically extracted from farm crops, and a low priced product be the result, agriculture may assume an enviable place among the industries of the world.

A specific crop which is representative in that it is enjoying an increasing demand by a widening market through research is the soybean. The soybean enters into the manufacture of many products. The following are a few of the products in which the soybean plays a part: paint, glue,

printing ink, rubber substitutes, breakfast foods, candies, livestock feeds, and many plastics. This crop is exemplary of what can be done by research to find new markets and means of disposing of products of the land. As plant chemistry uncovers new methods of utilizing plant material, the farmer will be more likely to find a favorable market for the fruits of his labor. Anyone interested in soybean culture, may profit by writing processors of soybeans regarding market information, or any other information that is desired. The Archer Daniels Midland Co., 600 Roanoke Bldg., Minneapolis, Minnesota, is the leading processor of soybeans in Minnesota.

Another product that is being subjected to extensive research is the sweet potato. Dr. H. G. Knight, chief of the Bureau of Crops and Soils of the United States Department of Agriculture, reports that 420,000 pounds of sweet potato starch were produced commercially at a plant at Laurel, Mississippi. This new process will result in a substantial saving in the 300 million pounds of starch which we import annually. It is not altogether improbable that the potato may become a relatively expensive food on our dinner tables.

Not only farm products, but by-products as well are taking on importance through the resourcefulness of the plant chemist. Secretary Wallace in his 1937 report to the President makes note of the work being done in the Bureau of Chemistry and Soils. Chemists in the Bureau are continually developing new products from such agricultural raw materials as straw, cobs, fruits, and vegetable culls, and other by-products of the farm. Secretary Wallace states that of the aggregate of all material removed from the land, 60 per cent are by-products. Although industries can utilize a large percentage of these for raw materials, much is wasted. This should be converted into cash for the farmer. Some of the recent usages which have been found for these end-products are high grade cellulose from sugar cane bagasse, inexpensive furfural (oil by distillation) from cobs or hulls, and manufacture of charcoal fuel gas, organic acids, solvents, and residual cellulose fibers from other crop wastes. Greater use of agricultural by-products is notably demonstrated by the co-operative efforts of the Chemical Research Department of the United States Department of Agriculture and the Texas Agricultural Experiment Station. From surplus fruits, culls, and by-products, fruit juices, alcoholic beverages, vinegar, marmalade, candy, and volatile oil were manufactured and processed by several com-

mercial firms co-operating with the Experiment Station. Numerically, these firms increased from three in 1933 to seventeen in 1935. Evidence of the benefit to farmers is shown by the fact that the money paid annually to growers in Texas for citrus culls increased from $10,000 to $250,000. Here we have a concrete example in which the farmers' income has been substantially increased by scientific research. According to Secretary Wallace, 6,700 specific lines of research in agriculture are being conducted. What may be forthcoming from this extensive experimentation can only be guessed. However, this will surely point to a better agricultural situation than what the farmer enjoys today.

Let us examine what accomplishments have been made in agriculture for the control of obnoxious weeds. Crop yields have been reduced from 5 per cent to 50 per cent by weeds. As reported by Mr. E. W. Oliver, the addition of iron sulphate to the soil has entirely killed wild mustard, peppergrass, pigweed, sweet clover, and badly injured Russian thistle, sun-flowers, dandelions, dock, thistle, white clover, red clover, and alfalfa. It but slightly injured plantain, sheep sorrel, prairie rose, lambs quarters and was not injurious to small grains or corn. The cost per acre for spraying a 300-acre field with iron sulphate is estimated at $1.25.

In recent years, grasshoppers have become a serious menace to crops and rangelands in many regions in the Corn Belt and elsewhere. To meet these threatening plagues, science has come to the aid of the farmer. An effective means of combatting this enemy of our growing crops has been found. A mixture of an arsenic compound (usually sodium arsenite) and coarse bran, spread thinly over the area where the wingless young grasshoppers are lodging, will do the job. To reduce the expense of the preparation, sawdust may be substituted for a part of the bran.

Plants have probably become more susceptible to diseases because of the extensive in-breeding and cross-breeding of different varieties for the purpose of developing hybrids possessing specific qualities, as drought resistant, frost resistant, or the like. In the process, the hardiness of many such hybrid plants is lost, thereby more readily subjecting the plants to parasitic attacks and diseases. Means of preventing such reversals have been discovered. The controlled use of maleic acid would prevent any appreciable interference with the normal course of metabolism or any ill effect on food value. The "gray speck" disease of oats can be cured by the addition of

manganese to the soil. These are but a few of the "medicines" which are available to combat parasites and diseases for the general betterment of agriculture.

Soil Chemistry promises to be of much benefit to the agriculturist. By experimentation it has been found that the presence or absence of minute quantities of an element may have a pronounced effect on the crop plant. From Secretary Wallace's 1937 report to the President, note is made to proper placement of elements in fertilizers. Much improvement in this field has already been realized, and fertilizers to fit the soil may soon be procured by the farmer.

Water culture (growing plants in water instead of soil) has been given much publicity the past two years. By this process, Professor Gericke, Associate Physiologist of the University of California, produced a miracle. "Gericke tobacco climbed 20 feet; potato plants deposited hundreds of clean, white tubers . . . Professor Gericke's tomatoes, on an acre basis bore more than 200 tons! Further, he had ripe fruit four months and a continuous bearing plant for the ensuing nine months . . . Gericke potatoes made an acre crop of 2,465 bushels!" However, there is no danger of a vast and rapid shift from the farm to the greenhouse. "Professor Gericke frankly states that in the growing of grain the chemical cropper cannot compete with the farmer."

Food synthesization is being much discussed. Predictions as to the future of farming resulting from the manufacture of food in the chemical laboratory have been fantastic in some instances. To conclude that the future of agriculture is seriously endangered by the chemist is erroneous in light of the facts. Regarding commercial food synthesization, Mr. R. C. Burrell, Assistant Professor of Agricultural Chemistry of Ohio State University, has made the following statement: "Such a possibility is quite unlikely, indeed, well nigh impossible. . . . Furthermore, most foods are not simple compounds, but are complex mixtures of compounds . . . if the chemist should learn to synthesize all the individual compounds, it is doubtful if he will ever be able to do it as economically as the plant or animal."

It is the contention of one group of people that chemistry is ruining agriculture, while another group believes that chemistry will solve the agricultural problem. In answer to the extremes of thought, Dr. C. M. A. Stine, Vice-President, E. I du Pont de Nemours and Company, has written the following: "The truth of chemistry in agriculture lies somewhere between these extremities, but it inclines toward

the second view. Food compounded in pills is a technical probability, but a most remote practical probability. Man is too fond of meat, vegetables, fruit, milk, and bread to desert them for centuries to come."

An article, "Chemistry Wrecks the Farm," appeared in the August, 1935, number of the Harper's Magazine. As the title suggests, the article paints a dismal picture for agriculture of the future. Dr. A. R. Gortner, Chief of the Division of Agricultural Bio-chemistry at the University of Minnesota, has written a critique concerning this article, which calls attention to misstatements and obvious distortion of scientific facts. A representative statement from the critique follows: "I grant that given adequate amounts of $300 an ounce materials, a chemist in the future might be able to put together a few grams of these things that the plant makes by the ton, but no one but an idle dreamer will ever suggest that man is going to do that sort of a thing in the laboratory."

While it is obvious that agriculture is in no apparent danger of revolution by water culture or "test-tube farming," chemistry will have much influence on agriculture. This is clearly intimated in a paper that was read before the American Chemical Society by Mr. E. P. Armstrong about two years ago. He said, in part: "One of the greatest problems of tomorrow is to discover what chemical substances in food, if any, can give intelligence, courage, age, and alertness, to the inhabitants of a city."

Agriculture has not enjoyed the prosperity that has characterized many of our other major industries. Why does the farmer oftentimes fail to receive enough for his produce to pay the cost of production? Agriculture must keep in step with the advancement of science to reach a parity with contemporary industries. A general awakening and acknowledgement of this fact by the agricultural contingent of our population, as well as our entire citizenry, is necessary. When scientific methods of farming are more generally pursued and aid through the medium of plant chemistry is intensified, agriculture will march on to the higher reaches of profitable and successful endeavor.

Heavy Grain Feeding Paid

Condensed from The Farmer

DURING the past winter on a group of 60 yearling grade Shorthorn steers fattened for market at the Experimental Farm at Waseca, Minnesota, condition made the difference between profit and loss. The four lots of 15 steers each were fed varying amounts of corn-and-cob meal as their grain, beginning with all the corn-and-cob meal they would eat for the steers in lot one, three-fourths this amount for lot two, one-half for lot three and one-fourth for lot four. Over a 112-day feeding period, the steers in lot one ate 20 pounds of corn-and-cob meal per head per day; those in lot two, 15 pounds; lot three, 10 pounds; and lot four, 5 pounds.

The steers in each of the four lots received 12 pounds of corn silage per head per day throughout the trial, and one pound of linseed meal per head per day throughout the trial. The steers in each lot were then allowed to eat as much cut alfalfa hay of good quality as they would. Those in lot one ate 2.11 lbs. of the alfalfa per head per day; lot two, 4.19 lbs.; lot three, 8.60 lbs., and lot four, 11.01 lbs.

The average weight of the steers in each lot at the beginning of the trial was 719 pounds. Lot one gained 2.44 lbs. per head per day; lot two, 2.13 lbs.; lot three, 2.01 lbs.; and lot four, 1.90 lbs. The selling weights were: for lot one, 992 lbs. per steer; lot two, 958 lbs.; lot three, 944 lbs.; and lot four, 932 lbs. The selling price per pound at the South St. Paul market on April 4, 1938, was: for lot one, $8.50 per 100 lbs.; for lot two, $8.00; lot three, $7.75; and lot four, $7.50. The cost price was $7.40 per 100 pounds.

Feed charges were as follows: 50 cents per bushel of corn, $4.50 per ton of corn silage, $13 per ton for cut alfalfa, and $35 per ton for linseed meal. Figuring cost price at $7.40 per 100 lbs at the beginning of the 112-day fattening period and figuring the selling price as secured, lot one (the lot fed the full feed of corn-and-cob meal) showed a margin over feed cost of $3.28 per head; lot two a loss of $1.65 per head; lot three, a loss of $4.17 per head; and lot four, a loss of $5.03 per head.

Feed costs per 100 lbs. gain were: for lot one, $8.38; lot two, $8.50; lot three, $8.64, and lot four, $8.01. It is seen from the above that the larger daily gains, the higher condition and

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consequent higher selling price per pound for the cattle fed the heavy grain ration in lot one, much more than balanced the lower feed cost of lot four and made the heavy grain feeding most profitable.

A feature of this trial that is of special interest is that the cattle used were purchased on the market at South St. Paul on September 16, 1937, at an average weight of 550 lbs. and at a cost of $7.40 per 100 lbs. delivered to the Experimental Farm at Waseca. The entire group of cattle was pastured for a short time on a mixed grass pasture, a short time on partially-grazed Sudan pasture, and for a time on corn fields from which seed corn had been husked. During this time they were fed in addition a little bundle corn. They were taken from the corn field to the feedlot and weighed into the Experiment on December 10, at the average weight of 719 pounds. They had thus gained 169 pounds from the purchased weight of 550 on September 16. Because it was just about impossible to determine accurately the value of the feed salvaged during this period, no accounting for the period was attempted; and, instead, the cattle were arbitrarily charged into the experiment at the purchase price rate per 100 pounds of $7.40.

Another interesting observation is that at the time of purchase these steers graded medium feeders and cost only $7.40 per hundredweight at a time when choice feeders were costing $10 per hundredweight. On the day they were sold, the price of $8.50 received for the lot that had been fed the full feed of grain sold only 25 cents per 100 pounds below the top of the market for fat cattle.

The lesson from this feeding trial is that fattening cattle cannot be used as a means of marketing large quantities of cheap coarse feed, but must be fed liberally on concentrates.

THE number of cubic feet of silage needed by a herd can be determined by multiplying the number of cows to be fed by the number of days in the feeding period, since the average cow will consume a cubic foot of silage each day. For example, to feed a medium size herd of 20 cows 180 days would require 20 x 180 or 3,600 foot of silage. A cubic foot of silage weighs around 35 pounds.—*Southern Planter*

New Pyrocide Dust

Condensed from Market Growers Journal

AFTER three years research and experimental work, McLaughlin Gormley King, announces its new Pyrocide dust, standardized to give complete uniformity in killing power, through a new principle involving a stabilized dry pyrethrum dust. It is said to be the first of its kind, retaining its strength for six months when stored at 95 degrees Fahrenheit, where ordinarily such conditions result in 30 to 40 per cent loss of strength.

Mr. Gnadinger, chemist who developed the Dry Pyrocide, used an entirely new theory in connection with both pyrethrum and derris by extracting the toxic principle and placing it on the *outer* portions of the particles of the finished dust, so that this toxic principle goes three or four times as far as when used in the ordinary forms of powdered derris and pyrethrum. An important feature of this new way of concontrating the killing power consists of shipping the concentrate (Dry Pyrocide) to licensed manufacturers at great saving in freight rates. The licensees then make the finished dust from locally available talc, sulphur or other suitable dilutents.

Some 20 Experiment Stations have been or are at work on tests of the new insecticide, which is said to be effective against even the squash bug, though the manufacturer is not and will not claim control of squash bug until the experiment stations have produced conclusive results. Effectiveness has been reported conclusively against Mexican Bean Beetle, cucumber beetles, cabbage worms, aphids, thrips, leaf hoppers on beans and many other pests. Pyrocide Dust has been patented.

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Regular Breeding and Vitamin E

Condensed from Breeder's Gazette

A. J. Pacini, Ph.D.

EVERY breeder and dairyman knows that the proper balance of food has a strong influence on the productive qualities of the animal. An animal is only as good as the food it consumes. Badly selected and improperly balanced rations make for defective, unprofitable animals.

In the study of nutrition for both humans and animals, scientists have discovered certain substances in foods which promote growth, maintain health and protect the body from certain nutritional diseases. These substances are called vitamins. The breeder is particularly familiar with Vitamin D, the sunshine vitamin, which is of vital importance in building bones, and teeth, and in preventing abnormal bone growth.

We also know now that Vitamin E in the diet has a large influence in promoting maximum breeding efficiency. Studies by numerous authorities have indicated that Vitamin E deficiency in the ration causes infertility and irregular breeding. This should not be confused, however, with sterility and breeding difficulties caused by infection and disease. Skilled veterinarians should quickly and certainly distinguish these different causes. But when mechanical and infectious disorders are ruled out, and abortion or sterility continue to exist, the Vitamin E deficiency must be considered.

Vitamin E is found in many foodstuffs but in limited and varying quantities. The average ration does not contain enough of it to supply the needs of the breeder cow, because her milk and butterfat production has been stepped up far beyond the original plan of nature. The richest natural source of Vitamin E is wheat germ oil. Commercially available wheat germ oil, however, must be carefully prepared to be effective. If it is obtained from even slightly rancid wheat germ, it is lacking in Vitamin E, because rancidity quickly destroys the vitamin. If it is solvent extracted, even with ether in the laboratory, it may be ineffective. Cold pressed wheat germ oil, while much more difficult to prepare, is the safest method of extraction, and then the only assurance of potent Vitamin E is dependence upon a reliable and authentic processor.

As ordinarily obtained by cold

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pressure from selected, nonrancid wheat germ, wheat germ oil presents two remarkable properties. It does not rancidify. In fact, it is so markedly resistant to oxidation as to confer this property also on other oils, including fish-liver oils. Next, its Vitamin E content is such that about three minims (about ten ordinary drops) of the oil are entirely adequate to prevent sterility in the human. No excess of wheat germ oil has ever been proved harmful, so that to insure the correction of dietary abortion and fertility, it is probably better to err on the side of excess rather than too little.

The best results are obtained by giving the oil daily for a month before the breeding season. Others furnish the doses indicated every day throughout the period of pregnancy of the animal. The total amount of oil required to insure fertility may be given in one single dose, if desired; but the effect will require the same length of time as though single doses had been furnished. The oil is simply stored in certain tissues and absorbed slowly.

Wheat germ oil may be given by mouth, or by injection intramuscularly or intravenously. In any case, the results appear to be the same.

Since milk of all animals is deficient in Vitamin E, it is advisable that the mother be fed wheat germ oil throughout the suckling period. About one-third of the vitamin taken daily by the mother passes into the milk. This is true also in the case of milch cows, providing the Vitamin E is furnished as wheat germ oil. If furnished as wheat germ, it does not appear to be true.

There can be little doubt that a nutritional element having to do with the all-important function of reproduction, will quickly surpass in interest and in vitality all other vitamins. This it should not be permitted to do. Vitamin E should, however, be furnished with its alphabetical fellows, particularly with oils and concentrates containing Vitamins A and D.

Punchinello

PUNCHINELLO, a new citrus fruit with a punchy taste, has been successfully grown, but is not yet sold commercially. It is a half orange and half lemon and is extremely juicy. The flavor is a little on the sour side. The fruit comes from the southwest coast of Florida.—*The Furrow*

Water Works for the Farm

Condensed from Electricity on the Farm

Herbert C. Angster

Secretary, Electric Water Systems Council

TREMENDOUS advances have been made in farm water systems in recent years. The modern water system is entirely automatic and should require only an occasional inspection to check mechanical condition and state of lubrication.

The term "automatic" in this case means exactly what it says—a modern water system will:

1. Automatically maintain pressure at the faucets;
2. Start and stop automatically;
3. Lubricate itself automatically;
4. Be protected from damage due to excess pressure resulting from possible failure of any of the automatic devices.

There are two types of such automatic systems:

1. *Hydro-pneumatic system.* It consists of a pump and a closed or pneumatic storage tank in which a cushion of air is maintained under pressure to force water from the tank through the service pipes to the faucets.

2. *Gravity System.* This consists of a pump and an overhead tank. The tank may be placed in an attic or an elevated tower outside. The water flows from the tank to the faucets by gravity or pressure due to its elevation.

There are advantages and disadvantages for each system. The trend, however, is very definitely toward the hydro-pneumatic system.

One of the advantages of the pressure system is that a greater and more uniform pressure can be maintained. The matter of pressure is particularly important in case of fire.

Another advantage of the hydro-pneumatic system is that the pump and tank are more or less of a unit. This makes for greater ease in servicing, repairs, and drainage.

A large elevated tank gives some reserved storage which would be an advantage in case of power interruptions or pump breakdowns. A 42 gallon tank,

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however, will usually tide over any power shortage, and modern pumps are very reliable. The pressure tank is cheaper than a gravity tank and tower and will provide 20 to 40 pounds pressure whereas a gravity tank at an elevation of 25 feet would produce only 11 pounds pressure.

By locating the tank in the pit with the pump, positive protection against freezing can be assured.

The heart of the automatic water system is the pump. In every installation, regardless of size, type, or location, there are always three factors to be considered.

1. Suction conditions—which determine whether a shallow well or deep well type of pump is to be used and where the pump is to be located.

2. Water required—which determines the size of pump to be used.

3. Discharge conditions—which determine class of pump to be used, i. e., whether low, medium or high pressure.

From the standpoint of suction conditions, there are two general types of pumps: Shallow well or suction pumps and deep well pumps.

The shallow well pump is the type most commonly used. It is limited to 22 feet of suction lift. Contrary to the general conception, this type of pump does not "suck" water but rather creates a vacuum into which the water is forced by ordinary atmospheric pressure.

Every pump has two essential parts, namely the power end and the water end.

In the case of the shallow well pump, the water end is stationary or "built-in." In the case of the deep well pump, the water end or cylinder is separate thus making it possible to pump water from a depth greater than 22 feet.

Various sizes and models of shallow and deep well pumps are made to meet varying conditions of pressure and capacity.

The volume of water required is an important factor in the selection of the pump. When water is used for household purposes only, the size of the family or the number of persons using the water is all that need to be taken into consideration. If, however, lawn sprinkling, car washing, stock watering or other auxiliary uses are to be considered, then a careful analysis of the requirements must be made.

General Requirements

The actual consumption for each member of the family and for each animal will vary considerably with the season, climatic conditions, location, and other factors. In hot, dry climates or under high production, stock may drink considerably more water.

General Requirements

	Approx. Gallons per Day
For each member of the family, for all purposes, including the kitchen, laundry, bath and toilet purposes	35
Each horse	10
Each cow	15
Each hog	2
Each sheep	1½
Each 100 chickens	4
Drinking fountains	50 to 100

Home Fixtures

	Gallons
Filling the ordinary lavatory	1½
Filling the average bathtub	30
Flushing a water closet	6
Each shower bath	30

Yard Fixtures

	Gallons per Hour
¾-inch hose with nozzle	275 to 300
Lawn sprinkler	120

In selecting a pump it is, of course, necessary, for satisfactory service, to have a pump capacity in excess of the actual requirements for any given period.

For Example: If a ¾-inch nozzle is to be used for sprinkling, this will consume water at the rate of 275 to 300 gallons per hour, and it is therefore essential, to permit use of water for other purposes at the same time, to have a pump capacity in excess of 300 gallons per hour. Where a ¾-inch nozzle is to be used, we recommend the use of a pump having a capacity of at least 320 gallons per hour, which leaves available for other uses, water at the rate of 20 gallons per hour when the hose is being used.

In determining desired pump capacity even for ordinary requirements it is advisable to select such a size as will not necessitate the pump running more than a few hours per day at the most.

Whether the system is the hydro-pneumatic or gravity, the question of the size of the tank is an important one. Indeed, except for extreme cases where large quantities of water might be desired for irrigation or watering stock, the pump capacity is secondary to the size of the pressure tank.

The distinctive feature of the hydro-pneumatic system is that water is pumped into an air-tight tank. The air in the tank is compressed thus building up a working pressure that will force the water out of the tank as soon as an outlet is opened. As a rule, one-third of the tank capacity is air. Only about one-third of the water can be withdrawn before the tank pressure is reduced to below working pressure.

Thus it can be seen that the tank capacity of a home water system is very important. A five-gallon capacity tank would provide working pressure but only about one and one-third gallons of water could be withdrawn before the pump would start running. A motor consumes most

current in starting. The more times during the day the motor is started, the greater the cost of pumping the water.

Popular tank sizes are the 42- and 80-gallon tanks. The 42-gallon tank is the generally accepted standard of most water system manufacturers for the household requirements of the average family. On the other hand, the 80-gallon size, while more expensive, allows fewer stops and starts, and gives greater storage capacity to meet peak demands. As a general rule, a tank 20 times the capacity of the pump in gallons per minute should be used.

Air, of course, is soluble. Unless a constant supply of new air is provided by the system, the tank will soon become water-logged, that is, there will be too much water and too little air for pressure. To insure a constant supply of air, all of the better pumping units are equipped with an air pump. This device operates in conjunction with an automatic air-volume control.

The pressure switch, which controls the starting and stopping of the pump is set and tested at the factory. It should not be tampered with in the field. Ordinarily, home water systems operate with a range of 20 to 40 pounds pressure. That means when the pressure gauge shows the pressure has dropped to 20 pounds, the pump automatically starts, building the pressure up to 40 pounds or the cutting out point.

One pound of pressure will raise water 2.31 feet or, in other words, 40 pounds pressure will lift a vertical stream of water 92 feet in height. Considering that some pressure is dissipated by pipe friction, particularly where long pipe lengths are required, it is obvious that good pump pressure is desirable.

The matter of pump capacity and pressure as well as adequate tank capacity cannot be over-emphasized.

Trained Cows

A herd of Holsteins at Washington's Soldiers' Home responds to fire drills. When the fire bell sounds each cow runs—not walks—to the nearest exit, and in two minutes the entire herd of 195 is clear of the barns.—*The Furrow*

Boron Deficiency in Cauliflower

Condensed from Scientific Agriculture

Wm. Ferguson

Central Experimental Farm, Ottawa, Canada

MANY workers in different parts of the world have shown that the element boron has a very definite place in plant nutrition. A deficiency of this element has produced physiological diseases of grave economic importance in some of our cultivated plants. In recent years it has been found that applications of boron either as boric acid or borax will prevent such important disorders as brown-heart of turnips, and cork and drought spot of apples.

Deficiencies of this element may cause disorders which have not been recognized from symptoms evidenced in other plants.

In so far as possible it is one of the purposes of this laboratory not only to find the causes of nutritional disorders and means of their prevention, but also to anticipate such disorders. An experiment in this connection has brought to light very interesting information on the effect of boron deficiency in cauliflower plants.

Cauliflower seed, variety Early Snowball, were germinated in greenhouse soil. When large enough they were pricked out into 4-inch pots containing ground, washed sandstone. The plants were held in these pots until the root system was large enough to permit transferring to 2-gallon glazed jars containing ground, washed sandstone.

The nutrient solution supplied to these plants was based on that used by Hill and Grant. The amount of boric acid stock solution (1 gm. H_3BO_3 in 1000 cc. water) added to the feeding solution varied with the treatment from 0 cc. to 23 cc. The feeding solution was applied at the rate of 200 cc. weekly per plant. This was increased to 300 cc. as the amount of growth increased.

Parts per million of the elements in the feeding solution were:

The concentrations of boron in the feeding solution according to the treatment were, 0, 0.25, 0.5, 0.75, 1.0, 1.5 and 2.0 parts per million.

The plants under all the treatments continued to grow in a normal and healthy fashion until the curd began to show. From this time on the differences between the boron deficient plants

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and those receiving boron became increasingly more marked.

On the boron deficient plants the smaller leaves, surrounding the curd became deformed and twisted with the characteristic stunted appearance of boron-starved plants. This condition gradually became worse. Some of these smaller leaves became so deformed and stunted that they consisted of little more than the main stalk. From the time the curd appeared it remained very small, almost in a vestigial state. Very little of the usual branching of the curd took place and no flowers developed. The top of the curd remained brown in colour from the time of its appearance.

The boron-fed plants all showed normal growth regardless of the concentration of boron in the feeding solution.

When these plants were cut through from top to bottom the browning on the surface of the boron deficient curd was found to extend down into the flesh and even into the stalk. These internal areas presented much the same brownish, water-soaked appearance as the areas denoting brownheart in turnip roots.

The effect boron has had in producing large, healthy white curds as contrasted with the small, brown curds produced by boron deficient plants is noteworthy. Thus, applications of boron to the soil may prevent the formation of brown coloured cauliflower curds.

A concentration of 0.25 p.p.m. of boron in the feeding solution applied to plants growing in sandstone is sufficient to produce normal plants.

You Can't Stop a Hailstorm

Condensed from Southern Agriculturalist

HAILSTORMS occur in the United States every month of the year and over widespread areas. No section is immune. The United States climatological data show that they become more frequent during the spring and increase in number and in violence during the growing period. No crop is immune. They destroy grains, vegetables, fruits, tobacco and cotton alike. A hailstorm may be isolated, affecting only a few square miles, and, too, it may be broad enough to damage or destroy the crop of a whole county or several counties. The stones range from minute particles the size of a rain drop or they may be huge

missiles as large as baseballs.

According to figures published by the United States Department of Agriculture, the average loss to the principal agricultural crops, viz., wheat, corn, barley, flaxseed, rice, potatoes, tobacco, hay, cotton, fruit and vegetables, from hail and hailstorms is about 75 million dollars each year.

It is true that certain sections of the country suffer more from hailstorms than others, and these areas are known as "hail belts." On the other hand, U. S. meterologists, the men who devote their lives to a study of weather, point out that only a few sections of the country—a very few—can be said to be safe from the onslaught of destructive hail at some time or another. Since no one can say with certainty just where and when hail will strike, it seems only good business for a farmer to avail himself of the one and only protection offered—hail insurance! In that way credit is maintained and the farmer is independent of uncertain and expensive loans.—*J. E. S.*

Pascal Celery Thrice Grown

Condensed from The Western Farm Life

THAT Colorado's famed pascal celery is a thrice-grown product is no news to its growers, who have gained a national reputation for the excellent quality of their crop. Yet to others, the unique production methods hold much interest.

Late in February the celery seeds are planted in hothouse beds. In late May the small seedlings are transplanted to the open fields, where they grow to be about 2 feet tall. The celery plants are then plowed up and placed in long trenches 12 inches wide and to a depth that the entire stalks can be covered with straw and earth, except for a small air space at the top.

Within a short time the stalks begin to decay, generating heat and providing moisture which in turn starts a growth of stalks from the center of the plant. After a few weeks the white, crisp center stalks grow to about 12 inches in height. At harvest time the celery is removed from the trench, and the decaying outer stalks and new roots are trimmed away, leaving the tender, white celery hearts. The celery is then washed with water under high pressure, after which it is ready for grading, packing and shipment. It is bundled and sold in packages of a dozen stalks each.

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The Gypsum Industry in the Southwest

Condensed from Farm and Ranch

Frank A. Briggs
Editor

CHEMISTS take rocks and other raw materials into their laboratories and find out what they are made of, and then, through other processes discover how the various elements of the material, perhaps combined with other elements in proper proportions, can be made into valuable and useful articles and commodities. When they have completed their research along these lines, along come the mechanical engineers and construct machines for the economical processing of the materials thus made available. Thus are the natural resources of a country developed, and materials often considered worthless and in the way are found to be valuable.

Take gypsum, for instance. There are billions of tons of gypsum in Texas and Oklahoma. It was avoided by early settlers who moved west to open farms. Gyp water was not as palatable as the water in the older States. Some of it was most disagreeable while drinking it and in its after effects. Highly impregnated gyp land was not as productive as other lands, although gypsum has its agricultural uses. Today the gypsum deposits of these and other States are highly important.

Gypsum products have given us new ideas in building construction. They are particularly adapted to inexpensive construction of farm buildings. Wallboard of gypsum is being extensively used. It is easily put in place by any person who can use a hammer and saw. It can be painted, papered or decorated in various other ways to suit the taste of the housewife, and it is fireproof as well as an insulator against cold and heat. It also finds its place in construction and remodeling of chicken houses and other outbuildings on the farm. A product, which not many years ago was largely used in making plasters, now finds many new and useful outlets. In the laboratories of the various concerns manufacturing gypsum products, new methods of combining, refining and processing the raw mineral are constantly being discovered.

One of the latest experiments in the use of gypsum is in soil conservation work in the wind-

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blown areas of the country. It has been observed that the least obstruction halts the drifting of top soil. Therefore, in this experiment terraces were constructed and gypsum was spread along the tops of the ridges. When it set, it held the terraces and acted as an obstruction to the moving soil. The gypsum coating is easily broken and when cultivated, is quickly absorbed into the soil during the wet seasons.

Gypsum is also beneficial in conditioning acid soils. In this respect it is especially beneficial in the production of legumes when used as a top dressing. The peanut industry in some sections of the country is a large user of gypsum. Gypsum is used with great success wherever a soil flocculant or loosener is needed and wherever the soil is deficient in calcium.

Gypsum appears in the form of rock much as limestone or other rock deposits. That which has been exposed to the atmosphere for a long time is more or less disintegrated and is easily ground into gypsum flour. It contains more moisture than rock and requires more drying out before it is in shape for processing. Most of the rock is obtained by strip mining.

As the deposits of rock are either on or near the surface, the top layers of soil are removed by scrapers or drag-line dredges, and then the rock is quarried in the usual manner. It is blasted out, loaded into specially constructed cars and hauled to the plant. It is then passed through several crushing machines of great size and power, each one breaking it into smaller bits until it is in a form for grinding. It is ground into a flour consistency and sent through great calcining chambers and is later used in the manufacture of plasters, wall board or other commodities, or is automatically sacked and shipped in the powdered form.

Tomato Dip

TOMATOES can be kept at ordinary temperatures almost twice as long if an oil and wax mixture is placed over the stem scar, because that is where the tomato chiefly breathes. Dipping fruit and even vegetables in the emulsion adds to the length of their market season.—*The Furrow*

Our Responsibility With Manure

Condensed from Better Crops with Plant Food

Ford S. Prince

Agronomist, Agricultural Experiment Station, Durham, New Hampshire

IT is probably fair to state that over half the fertilizing value of manure is lost during the period that elapses between its production and its incorporation with the soil. Under ideal conditions some loss of nitrogen is bound to occur through the escape of ammonia in gaseous form. Unless sufficient bedding is used to absorb the urine this portion may escape, with a consequent loss of both nitrogen and potash. Exposure to rain causes manure to suffer much loss by leaching, and this loss affects the more soluble plant food and hence the most valuable portion. Drying permits nitrogen to escape; freezing withdraws water from the mass and results in serious nitrogen losses; and even after spreading, if the manure is not immediately incorporated with the soil, nitrogen is dissipated by being volatilized and carried off as a gas in the atmosphere. Fermentation, lack of compaction, and exposure of the surface of manure heaps to the air or weather are aggravating and contributing factors promoting losses. From the time manure is voided until it is intimately incorporated with the soil, it is subject to loss. Much of this loss is preventable by proper conservation methods.

The nitrogen that escapes into the air from manure is just as valuable as that which we purchase in the fertilizer bag. Potash, the greater portion of which is contained in the urine, is in solution and is as available to plants as potassic fertilizers. Phosphoric acid in organic form is probably more valuable than its equivalent in superphosphates, although this element is not subject to such major losses as nitrogen and potash. Besides these three important elements, manure carries all the minor ones that have entered into the nutrition of the feed stuffs eaten by the livestock. While there is little data available on these elements as manure components, it is quite possible that the more soluble of these are adversely affected by faulty handling of the manure.

No method of procedure has yet been devised to save all the

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fertility elements voided by livestock. To do so would involve catching all the excrement and harrowing it into the soil at once. The reason for such haste lies in the fact that urea nitrogen changes to ammonium carbonate rather quickly in the presence of air, and in this unstable compound the ammonia readily escapes into the air as a gas. The warmer the temperature the more quickly this transformation occurs. Under conditions such as are found in the average dairy barn this occurs probably in from 24 to 48 hours. Losses therefore are simultaneous with the change, and the losses are commensurate with its rapidity in unprotected manure.

Any substance that will absorb and hold gases, or a chemical material which will react with the ammonia and change it into a stable compound, renders manure less vulnerable to immediate loss. Adequate bedding to absorb the liquid will also catch some of the ammonia because of its porous nature. Of all the chemical substances that have been experimented with up to the moment to react with ammonia, superphosphate of a 16% or 20% composition has proven most satisfactory and effective. The net result of the use of this substance is to change volatile ammonium carbonate into non-volatile ammonium sulphate, a substance which is still subject to leaching but which will not escape in a gaseous condition.

True and effective conservation of manure involves the use of both these substances in amounts sufficient to adequately do the job for which they are designed. The function of bedding, primarily, is to absorb the liquid portion of the manure. Urine carries about one-half the nitrogen and four-fifths of the potash of the total excrement from cows. These materials are already in solution and are readily available if saved and preserved until they reach the soil. It takes 8 or 9 pounds of sawdust or straw to absorb the urine produced by an average dairy cow during a 24-hour period

If sufficient bedding is not used, free urine escapes either before or after the manure is stored or spread. Under ordinary conditions this may occur in the barn cellar, where it runs out through openings in walls or doors unless there is a tight floor. Or it may occur outside where the manure is piled until the farmer chooses to spread it, in which case it trickles or is squeezed out of the manure heap, resulting in a very serious loss. How serious depends entirely upon how much is lost. Since potash is so abundant in the urine, this element is lost to a greater degree than any other because of faulty methods of saving urine.

While it is commonly practiced in Europe, only a few farmers in this region have dug or constructed wells into which the urine may collect for later spreading. A short while ago I visited a farmer who was cutting hay from stands of timothy over 50 years old. These fields are yielding 2½ tons of hay per acre. Mr. Bell has been able to achieve this by saving the liquid portion of his manure in a well and using this along with the solid portion as an annual top-dressing. He has a heavy soil, a thick stand of grass, and the top of the soil feels like a sponge when stepped on, so thoroughly is it covered with organic matter.

The use of superhosphate as a manure preservative has long been advocated by scientists and is practiced by large numbers of dairymen. To be most effective, superphosphate should be spread in the gutter behind the cows after the stable is cleaned but before fresh bedding is put in. There it is, ready to perform its useful function, for it acts not only as an absorbent of the liquid itself but also reacts chemically with the nitrogen that changes into the ammonia form. The gutters should be tight, so that the liquid containing the superphosphate will not be lost.

The reaction that ensues when superphosphate is mixed with urine is a complex one, but it is relatively easy to understand the results that occur. Superphosphate itself is more than a phosphorous compound, for it carries gypsum as well as monocalcium phosphate. The gypsum or calcium sulphate apparently is more effective in actually holding ammonia than other compounds that may be present. Ammonium carbonate is changed by this material to ammonium sulphate, while in the process the monocalcium phosphate is reverted to the tricalcium form. At first thought this latter process might seem undesirable, but in a region of acid soils it is just the reverse, for the finely divided state of the tricalcium phosphate that is produced makes it readily available to plants, but in this form it is not water soluble and is not so easily fixed as the monocalcuim form by excess aluminum and iron in acid soils that prevail in the northeast region.

What chance does the farmer who does not superphosphate his manure have of saving this urea nitrogen? If he spreads his manure daily and harrows it immediately, his chances are good. If he spreads daily and does not work the manure into the soil he will lose the volatile ammonia due to drying winds or freezing weather, or both, unless rain falls before this occurs. This fact has been definitely established recently by Midgley and Weiser in Vermont.

On the other hand, if this farmer chooses to store his manure instead of spreading it daily, it is still subject to loss of escaping ammonia, although the loss may be less than if it is spread at a time when it cannot be worked into the soil. Spreading manure on frozen land or in the snow, especially on a field which is subject to washing, is always questionable practice because of loss by surface washing.

As a matter of fact, there are only a comparatively few days during the year when manure can be spread without some loss by drying or due to freezing. To prevent as much loss as possible, the land should be harrowed after spreading each day.

These findings by the Vermont workers mentioned limit to no small degree the use of manure for top-dressing, especially if no superphosphate has been used. They also cause us to wonder what untreated manure carries in the way of plant food as spread by the average farmer. While manure as voided carries in the neighborhood of 10 pounds of nitrogen per ton in the liquid and solid portions, it is doubtful whether more than half of this amount ever reaches the field. Losses of potash are probably just as serious, although this element would vary more than nitrogen with the effectiveness of the methods of bedding and saving the liquid portion, since the potash is not subject to volatilization.

A ton of manure has usually been considered to be equal in plant-food value to a 100-pound bag of 10-5-10 fertilizer. With these losses in mind it is doubtful if the average ton of manure carries more than a 5-5-5 equivalent in fertilizer elements. Likewise manure has been thought low in phosphorus, but it appears that even if it has not been superphosphated, the phosphorus content is at least as high as the other two elements.

If a farmer superphosphates his manure and uses bedding enough to absorb the urine and then spreads immediately on the fields or stores where the manure is not subject to leaching, he will reduce his nitrogen losses to the point where at least 8 pounds of this element will remain in each ton of manure, in which case he would be applying the equivalent of 100 pounds of an 8-5-10 fertilizer, not counting the phosphoric acid in the superphosphate which has been used. If this has been used at the rate of 30 pounds per ton of manure (1 pound per cow per day), then his manure would carry approximately an 8-10-10 equivalent.

In view of what is now known as to the perishability of manure, it appears likely that half of its value is dissipated before it is

actually worked into the soil where losses cannot further occur. If we assume that manure is worth $2 per ton and that half its value is gone before spreading, then the loss reaches an enormous total annually.

Superphosphating cow manure is a practice that should be adopted by every dairyman. Many boards of health are requiring that lime be used in stables to keep down odors, to make them brighter, etc. Superphosphate will do everything that lime will do and in addition will preserve the nitrogen content of manure, something that lime will not do.

Since the use of superphosphate in stables preserves nitrogen and even keeps the phosphorus available to plants in the soil over a longer period, it appears that its application in this manner is more of a conservation measure than when it is applied to the soil alone or as a component of mixed fertilizers.

In the Northeast daily spreading is inadvisable, if not impossible. This means that manure must usually be stored somewhere until spread. If stored, a roof over it is a protection from severe leaching. A tight concrete floor is a protection against loss from seepage.

It seems logical to conclude that conservation in the broad sense should mean saving as well as adding to the fertility of our soils. The losses that occur to farm manure constitute the greatest single draft on the productiveness of the soils of the nation.

New Oats Resist Disease

A final check of twelve oat selections from a Victoria-Richland cross—grown cooperatively this year by the United States Department of Agriculture and the Iowa experiment station at Ames—shows that one of the varieties yielded at the rate of nearly 108 bushels per acre, and all averaged 98 bushels per acre.

These new strains also possess resistance to crown and stem rust and smut, as well as high yielding ability and desirable grain characters. However, no seed from them will be available for distribution to farmers until further testing has shown which ones should be increased for commercial growing.

Poison Ivy and Poison Oak Control

Condensed from American Fruit Grower

W. H. Zipf

FOR a number of years, California workers have been using carbon bisulphide in an attempt to eradicate poison oak. In their experiences a single application of carbon bisulphide was made on numerous clumps of new and old plants, using two ounces as a dose, with the applications spaced 18 inches apart in holes 12 inches deep.

The number of applications varies according to the size of the clump treated. When the applications are spaced 18 inches apart, they should be alternated in adjoining rows, or staggered. Holes are made with any solid wooden or steel pole. The bisulphide is measured and poured in through a pipe reaching to the bottom of the hole. After the liquid has soaked into the ground, the hole is closed with dirt and tamped tight.

Carbon bisulphide is a heavy oily-like liquid which evaporates readily and forms a heavy poisonous gas, and is used more generally for killing ground squirrels and insects. This gas, being heavier than air, penetrates into the soil in every direction except where soils are extemely heavy or soaked with water. The best time of application is in the summer after the subsoil is drying out, provided the soil is not badly cracked.

While the use of carbon bisulphide is a compartively expensive treatment, one application is usually sufficient. Should weak sprouts appear the second year after the control measures were applied, these can be readily killed with smaller dosages of the liquid. Hand grubbing is probably the least expensive method of control, but with this method patches of poison ivy or poison oak are likely to appear year after year. Hand grubbing, too, must be done only by persons immune to the harmful effects of the plants.

In Gallia County, Ohio tests were made in the summer of 1937 with heavy, long-established patches of poison ivy beneath Ben Davis trees. The trees were about 50 years old and in weakened condition due to age, drought, and winter injury. A dry mixture of sodium chlorate was applied on May 30 and a solution of the same chemical on July 15.

Application of the dry mixture was made uniformly by hand under a still air condition. The solution was made up of one-half

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to one pound to the gallon and applied with a power sprayer, using a disk of 4/64-inch diameter in a spray gun which delivered one gallon per minute. Control of drift was easier with the solution but it was observed that severe injury occurred wherever the material came in contact with twigs, leaves, or fruit. This emphasizes the importance of spraying the ivy only.

A single application of three pounds of sodium chlorate per square rod on July 15 in this test gave excellent kill of ivy, and there was no visible injury to trees on October 16. But definite injury occurred to the trees following application of six pounds or more of sodium chlorate per square rod. It would therefore seem that the application need not be stronger than three pounds per square rod and might safely be less.

Also observed was the fact that a better kill was secured where the ivy was growing under the partial shade of mature trees than where the patches occurred in the open, and that some patches of ivy need light follow-up applications to complete the eradication.

C. J. Willard of the Department of Agronomy, Ohio State University, gives the following precautions in the use of sodium chlorate:

"Buy sodium chlorate in the manufacturer's original drum and store it in this or some other tight metal container in a detached outbuilding. Take special precautions to see that it is not mixed with sulphur in any form since such a mixture is dangerously explosive. Wear rubber boots when spraying. Chlorate ruins leather, and many a crippling accident has occurred, or a spontaneous fire has resulted, when a chlorate soaked shoe touched a tractor exhaust.

"Make up solutions outdoors. Do not spill the dry salt or the solution on floors, wagon beds, or anything burnable. Use metal containers for chlorate solutions. If wooden tanks or containers must be used, keep them full of clear water for some weeks or months afterwards. Do not smoke or come near any fire while spraying or if wearing clothing worn while spraying. Wash thoroughly or destroy clothing, sacks, or other cloths which have been soaked with the solution. Sprayed areas are a fire hazard until after a heavy rain."

Sodium chlorate precautions as given in this article must also be followed for carbon bisulphide. This liquid is highly inflammable and explosive when mixed with air. For this reason a flame or even a spark from hitting metal on metal or from an electric switch may cause an explosion of gas.

Rambouillets

Condensed from Sheep Breeder

Dr. Frederic Hultz
University of Wyoming

THE American Rambouillet Sheep Breeders' Association was organized in 1889. The modern Rambouillet in type does not differ so greatly from the kind that Baron von Homeyer first sent to the United States.

The reputation of the Rambouillet rests upon a combination of the excellence of two products, namely wool and lamb. There may be a few breeds of sheep that excel the Rambouillet in ability to produce market lambs, but those same breeds are quite markedly inferior to the Rambouillet in amount and quality of wool. There are, perhaps, one or two other breeds that will produce a higher yield of wool per sheep, but these same breeds are inferior to the Rambouillet in their ability to rustle for feed on the open range, to lamb out a high percentage of increase, and to maintain themselves easily and economically under sparse conditions of feed. Since the sheepman's profit is to a large extent dependent upon economy of operation, this ability of the Rambouillet to maintain itself at low cost is an important feature in its popularity.

While farm sheep raising is on the increase the great centers of sheep production in this country are still located west of the Missouri River, and the bulk of the wool and lambs produced in the United States originate in the so-called range area of the eleven Western States and Texas. In this section it is estimated that at least 90 per cent of all the sheep are of fine wool ancestry, and the Rambouillet is by far the most important of the fine wool breeds in the point of numbers. The position of the Rambouillet in United States sheep production is, therefore, clearly evident. Besides the breed's hardiness, economical maintenance, and a natural instinct to flock or herd together, Rambouillet sheep have given a high account of themselves in the nation's feed lots and shearing pens.

In describing the Rambouillet sheep, as studied in a series of experiments covering a period of eight years at the Dubois, Idaho, United States Sheep Station, Cir-

Reprinted by permission from the Sheep Breeder, Chicago, Illinois

cular 308 of the United States Department of Agricultural states, "Under range conditions at the United States Sheep Experiment Station, Rambouillets are large, vigorous sheep, producing lambs that are desirable for stocking and feeding purposes, and fleeces of fine or half-blood wool, moderate in length of staple and yield of clean wool." This same report characterizes the Rambouillet as follows in the specific points covered in the study: Number of lambs per 100 ewes, 99; number of lambs weaned, 72; weight of lambs at weaning time, 71 pounds; pounds of lamb per ewe bred, 51; pounds of grease wool per ewe, 11.72; average staple length of mature ewes, 2.33; average staple length of yearling ewes, 2.60; and clean yield of yearling fleeces, 4.81 pounds.

Indispensable

The animal husbandry extension service of the University of Idaho has the following to say about Rambouillets: "A large number of Rambouillet lambs are fed out in Idaho each winter. In fact, the majority of the feed lot lambs are of the Rambouillet breeding, either so highly bred as to be practically purebreds, or with an outcross ranging from half to quarter blood. The Rambouillet lamb, either full or half bred, constitutes almost all the market lambs from Idaho after January first. In the feed lot they have a number of advantages. They are hardy and are protected from the storms and unfavorable weather which comes at intervals. Practically all lambs in Idaho are fed without shelter from the storms. An additional argument in their favor is that they eat more slowly and carefully, and feed lot losses are lighter than in the case of any other breed we have ever fed out. The Rambouillet is indispensable in the range country."

One of the most difficult accomplishments in the sheep business is to maintain a proper balance between wool and mutton ability in either farm or ranch sheep. The Rambouillet does this, almost automatically.

How Much Calcium?

Condensed from The Poultry Item

C. E. Lee

THE need for large amounts of calcium in the diet of the laying hen was pointed out by Dr. Wheeler, of the Geneva, New York, Experiment Station more than 30 years ago.

Determinations of the exact calcium requirements of laying hens are, however, rather few. From a series of feeding experiments carried on at Cornell University, about 5 years ago, it was concluded that "1.65% of calcium appeared to be just sufficient to supply the needs of laying hens for calcium under the conditions set by this experimental work." In this study attention was given not only to egg production but also to egg-shell strength, egg-shell ash, and the level of calcium in the blood.

Research at the Washington Agricultural Experiment Station, reported in 1934, indicated that 2¼% of calcium in the laying ration was adequate or more than adequate.

The mineral requirements for egg production are, of course, directly related to the mineral content of the egg, particularly the shell. An average egg weighing 60 grams contains the following amounts of inorganic elements expressed in grams.

It is seen by this that the amount of calcium required is far more than that of any other mineral and this is contained almost entirely in the shell, only 0.026 grams being required for the yolk and 0.004 grams for the egg white.

N—1553 P—123.7 K—929.4 Mg—96.4
Ca—400 S—127 Cl—352
Fe—33.04 Mn—0.29

Calcium	**1.98**
Magnesium	**0.027**
Potassium	**0.067**
Sodium	**0.073**
Phosphorus	**0.115**
Sulphur	**0.114**
Chlorine	**0.088**
Iron	**0.001**

Oystershell flour, carrying approximately 96% carbonate of lime, as included in the mash will usually supply enough calcium for the shells of 7 to 8 dozen eggs. A hen laying about 200 eggs per year must have practically 1 lb. of pure calcium to meet her requirements. Ordinarily, as shown by records at various egg laying contests, heavy laying hens will consume 3 to 4 lbs. of oyster shells per year. This, when added

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to that supplied in the mash, makes the annual calcium intake nearly twice the amount needed to produce 200 eggs yearly.

Probably some of this oyster shell is actually utilized as grit to assist in the grinding of the grain consumed by the bird. A supply of hard grit which will act as an effective grinding agent will usually result in a lower consumption of oyster shell per bird per year.

The use of shells from oysters, clams, mussels and other shell fish dates back to very early times. Some of the earliest known writers on poultry husbandry cautioned the poultrymen to be sure that a liberal supply of shells was kept before the birds at all times. Many of these old-time poultrymen purchased shells just as they came from the fisheries and pounded them up with a sledge hammer, for their birds.

In recent years there has been an adequate supply of properly prepared oyster shells available to commercial poultrymen, though there is still a very considerable quantity of poor oyster shell on the market. To be safe for laying hens, oyster or other shell must be entirely free from meat or other animal matter which is likely to decay and thereby cause digestive trouble and perhaps serious mortality in the flock. Shells that are properly prepared are heat-treated to burn up animal tissue remaining on the shells and to fully sterilize them. Properly prepared shell also is carefully screened and graded so that the sizes for laying hens are free from the fine particles which hens do not consume readily and which may therefore cause considerable waste in feeding, if present.

The use of oyster shells for the feeding of laying hens has become such a settled matter that for many years no other source of calcium was suggested. Work at the Wisconsin Station years ago showed that clam shell was not as efficient as oyster shell and various other investigations have established the fact that other common shells were not nearly as good a source of calcium as high grade oyster shell.

Minerals in the Mash

In recent years there has been a very decided trend toward the inclusion of more mineral matter in laying mashes. It seems that first this was neglected entirely, and then in many cases poultrymen and feed manufacturers went to the other extreme and included far more mineral matter than was necessary or advisable. In fact for a time many poultrymen bought feeds largely on their mineral content, forgetting the far more important values in the ration.

It is true that research has given some indication that oyster

shells or any other source of calcium, outside of the prepared ration, is not always assimilated rapidly enough by the birds to give the greatest egg-shell strength and perhaps also the greatest egg production and hatchability. *The addition of 2% or 3% of some calcium carbonate material to the mash part of the scratch and mash ration, or half that amount to the all-mash laying ration appears to give improved results.*

There has been some question as to whether all the calcium necessary for egg production could be included in the mash and whether that would give best results. It is, of course, easy to see that the requirement of birds for calcium will vary quite widely according to whether they are laying at a high or low rate of production. Certainly the amount of calcium required by birds laying at a 30% level, for example, is tremendously different from that required by a flock laying at a level of 70%, yet both levels of production are well within the range of common experience with commercial flocks.

It is perfectly obvious that it is not desirable to supply the hen with large amounts of calcium which she cannot use and which she must excrete from her system, thereby placing an abnormal load on the kidneys. Supplying a *fixed* amount of calcium carbonate in the mash, particularly where mash and scratch are used, would seem to be a poor way of correlating the mineral intake of the bird with her egg production, providing that such a level of calcium is set at a point supposed to be adequate to take care of *all requirements* of the birds at *high* levels of production, without access to a supply of oyster shell as a supplement to the ration.

As a matter of fact, research and experience with commercial flocks seems to have finally settled the question. Provision of a limited amount of readily available calcium in the laying mash, plus an additional supply of high grade oyster shell, available to the birds at all times, is by far the most popular practice. A hard granite or mica grit is fed separately to take care of the mechanical requirements for grinding the feed, without interfering with the mineral balance of the ration.

A wide range of materials have been used in the mash to furnish part of the calcium requirements of the birds. It seems clear that such materials must meet certain definite objectives, as follows: First—the material furnishing calcium must be quickly and easily assimilated by the bird. Second—it must provide a high percentage of calcium carbonate. Third—it must be free from large amounts of magnesium or

even small amounts of fluorine or other poisonous or undesirable elements. Fourth—it should preferably be free from large amounts of phosphorus or any other mineral except calcium, otherwise it will be difficult to preserve the exact mineral balance we desire in the ration. Fifth—it should be available generally and at reasonable cost.

Let us examine the mineral materials which are sometimes used in the mash as sources of calcium.

Bone

Bone is a substance which was widely used in poultry rations, in the form of bone-meal, for a good many years. It is now seldom found in rations. Its chief disadvantage was in the fact that it contained a large percentage of phosphorus so it was always difficult to get the exact mineral balance in the ration on account of these two elements being tied up together in the bone. Another disadvantage, primarily from the standpoint of chick rations, was the fact that the use of bone-meal was found to increase the tendency toward perosis (slipped tendons) in chicks.

Since most rations contain fairly large amounts of meat scrap and fish meal, there is always a considerable amount of bone present in the ration whether any additional bone-meal is added or not. Bone-meal therefore would usually add to an already adequate amount of phosphorus in the ration and therefore there is no justification for using it in preference to high grade limestone such as calcite flour with a low magnesium test, or oystershell flour.

Bone-meal is much more expensive than these other sources of calcium and its use in the laying ration cannot be justified on a cost basis unless some peculiar formula is used that is low in meat and fish and therefore in the necessary phosphorus.

Limestone

There are many different kinds of limestone and unless we know the exact chemical analysis of the limestone offered, there is no way in which we can tell whether it is desirable or undesirable to use in the ration. Some limestones contain large amounts of magnesium, which is undesirable in the laying ration. Other limestones contain considerable amounts of fluorine which is a poisonous substance when present in a ration to any significant amount. No material is desirable as a mineral supplement in a ration which contains more than a very small fraction of a per cent of fluorine.

High grade limestone is about the cheapest material which could be classed as permissible as a source of calcium in the ration. The great difficulty with ordinary

limestone is the very wide variation in the analysis of different lots, even from the same quarry. Nature doesn't make limestone rock all alike and we find that limestone from one part of a quarry may test quite different from the limestone which is taken out of some other part of the same quarry. For example, tests in our laboratory have shown a certain brand of limestone varying all the way from about 4% to more than 9% of magnesium. Many samples of limestone are not pure but show the presence of many other undesirable materials.

Variation is particularly great in phosphatic limestone and this is only satisfactory when produced under the most careful conditions with the analysis of the finished product checked by a control laboratory. This phosphatic limestone has one advantage, in view of recent discoveries in mineral nutrition, in that it frequently provides considerable amounts of manganese in the ration. It also contains various amounts of iron and other mineral substances which may be of real value in the ration.

Such material has the disadvantage of carrying both calcium and phosphorus and therefore increasing the difficulty of balancing the ration exactly in its calcium and phosphorus content, a matter which is especially necessary with rations for chicks and growing stock and desirable even in the ration for laying hens.

Dolomitic limestone was proved to be thoroughly undesirable by research work at several different experiment stations.

Rock phosphate has also been used to some extent in poultry rations as well as in rations for other livestock, but is no longer commonly used because of its demonstrated injurious effect due to the presence of large amounts of magnesium and fluorine.

Calcite

Calcite is another type of limestone, of which there are a number of deposits in different parts of the United States. Calcite differs from ordinary limestone in that it is a crystalline form and is harder. There seems to be some indication that a somewhat better shell quality may be obtained by the use of a satisfactory grade of calcite flour in the mash instead of the other forms of non-crystalline calcium bearing minerals, but there is little experimental evidence on this point.

Calcite, like other forms of limestone, may vary considerably in analysis and in content of other minerals besides calcium. Samples of calcite examined in our laboratory have shown a very much higher content of magnesium than we regard as desirable, while other samples have shown a very satisfactory analysis. As

a rule, calcite seems to be reasonably free from fluorine.

The use of pulverized oyster shell in the form of a fine flour, as a source of calcium in the mash is quite widespread and the results, where a strictly high grade product is used, are satisfactory.

Probably no form of mineral matter used in the mash will supply calcium in a more readily assimilable form than oyster shell. The only disadvantage seems to be that the cost of a really high grade oyster shell, free from dangerous animal matter, is likely to be considerably higher than the cost of an equal amount of calcium in some form of limestone.

In any event, there is a sufficient variety of calcium-bearing materials available to provide a good and an economical source of calcium in the ration in any part of the country.

The question of whether to supply all the required calcium directly in the mash, or whether to put part in the mash and depend on oyster shell for the rest, has been clarified by a piece of research work carried out by the Rhode Island Experiment Station.

The Standard Ration gave eggs with a greater shell strength in both years of the experiment.

It was also noted that the eggs per bird were noticeably increased with the standard ration containing 2.3% calcium carbonate in the mash, *plus oyster shell.* To get 2.3% of actual calcium carbonate, it would generally be necessary to use close to 2½% of oyster shell flour in the ration.

It is interesting to note from this experiment that the pounds of feed required to produce one dozen eggs were very much affected by the feeding of calcium. Whereas, the ration containing only 1% of calcium carbonate in the mash required 10.19 lbs. of feed to produce one dozen eggs, we find that where a level of 8% calcium carbonate was used in the mash, only 7.85 lbs. of feed were required to produce one dozen eggs, and where 2.3% *Calcium carbonate in the mash was supplemented by the feeding of oyster shells ad libitum,* that only 7½ lbs. of feed were required to produce a dozen eggs.

Apparently there was little difference between the calcium intake per bird with 5% calcium carbonate in the mash and the standard ration with 2.3% calcium carbonate plus oyster shell, yet the results were in all cases better with the standard ration plus oyster shell. This would lead us to believe that the birds were somehow better able to assimilate the calcium they needed where just a moderate amount was present in the mash and where they

had free access to oyster shells at all times, *allowing them to consume what they wanted when they needed it.*

Calcium and Hatchability

It is clear enough that whatever source of calcium may be used that *it is necessary to have the proper amount of calcium in the mash* and that *best results will be obtained where this is supplemented by the feeding of oyster shells in separate hoppers and accessible to the birds at all times.*

Lamb Feeding Experiments

Condensed from Kansas Farmer

THE largest and most inclusive test of feeding Western lambs was recently completed at the Garden City Experiment Station.

This year's experiment consisted of 12 lots of 42 lambs each. To give further information on the practice of deferring grain for lambs 30 days after starting on feed, comparisons were arranged on heavy, medium and light weights. There was little difference anywhere along the line, in fact much less than in other trials. Heavy lambs showed the greatest advantage for deferring grain.

Dwarf yellow (crook-neck) milo, kafir, Wheatland milo, and sumac compared as grain for fattening lambs, produced the higher gains in the order named. Returns from the dollar and cents angle also were in the order named, with a total range of $1 a hundredweight between milo and sumac.

Comparison between ground milo fodder and sumac fodder continued to show no apparent advantage for either.

Another series gave a comparison of sumac silage, ground sumac fodder, and a combination of the two in which the fodder was fed 60 days and the silage thereafter. Largest gains were made by the fodder, next by the combination feed, and the lowest by silage alone. Feed costs of gains also were worth noting; $5.34 a hundred for the fodder lambs, $5.92 for the combination, and $6.76 for silage.

Feed prices charged in the experiment were 90 cents a hundred pounds for sorghum grain; $32.50 a ton for cottonseed meal; $5 a ton for ground stover with no grain; $3.50 a ton for silage; and $1 a hundred for limestone.

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The Effects of Flies and Fly Sprays On Dairy Cows

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ALTHOUGH nearly 30 years have elapsed since it was first demonstrated that the production of dairy cows is not lessened by their exposure to flies, and that the use of fly repellents cannot be justified on economic grounds, dairymen are still spending in the aggregate, vast sums of money for commercial animal sprays.

This growing interest in the problem, the improved specialized research equipment available at this station (including a psychrometric room and a respiration chamber, both large enough to accommodate two mature cows) and the general scientific knowledge that has been developed since the original researches were conducted 30 years ago, all seemed to warrant a reinvestigation of flies and fly sprays in their relation to dairy cows.

The work reported herein was begun in 1925. The study involves a consideration of (1) the effect of flies on the cow, (2) the effect of sprays on the flies and (3) the effect of sprays on the cows. Certain sprays were found to be effective in repelling flies for but an hour or two, while others protected the animals for 24 hours or more. Previous to the time this experiment began, no one had attempted to determine, by controlled experiments, the effect of fly sprays upon the health and production of the animals. In our work we used high producing cows, exposing them to attack by great numbers of each of three different species of flies in pure cultures.

Flies Used

House Fly—Of the three species studied, this is usually the most numerous inside the dairy barn. Possessed of non-biting mouth parts, it depends upon exposed foods, liquid or semi-liquid, and therefore probably annoys the cattle only through walking about on their bodies.

Stable Fly—The adults are not particularly noticeable, as they do not congregate on the animals and do not differ strikingly in appearance from the house fly. The stable fly spends most of its life hidden away on

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the walls of buildings or on vegetation and comes to the animals for its meal of blood approximately once a day, generally in the morning. The favorite point of attack is the legs or underline. The stable fly fed in the laboratory required approximately nine minutes to secure an average meal of 15 milligrams of blood, an astonishingly large amount when it is noted that the average body weight before feeding was 7.4 milligrams. On exceedingly hot days, when the temperature was above 100° F., the stable flies fed twice daily, once in the early morning and again in the late afternoon.

Horn Fly—This insect is probably the most noticeable fly that annoys cattle and for that reason its importance is probably overestimated. In laboratory trials we have never been able to make this species bite more than once a day, the average meal consisting of 3.2 milligrams of blood.

The Experiment of 1925

Eight relatively high producing cows, divided into 4 similar groups, were placed in 4 screened stalls, the two cows of each group being housed together. All groups were fed and cared for in the same manner, being milked twice daily and furnished, in accordance with their production, the same ration that they had been receiving prior to the experiment. Such data as amount and kind of food eaten, amount of water drunk, milk and fat produced daily, and body weight of the cows were kept, and in addition, the temperature and relative humidity in the stalls recorded.

During the first 10 days (June 5-14) all cows were kept free from flies. For the next 30 days flies were liberated daily in all of the stalls except that of group A, the controls. During the period, group B was exposed to a total of 73,000 horn flies; group C to 71,000 stable flies and group D to 140,000 house flies. Then followed a month in which all the cows were sprayed. As before, all groups except A were exposed to flies; group B to 19,600 horn flies and group C to 23,250 stable flies. In the case of group D, however, stable flies were substituted for house flies, 26,800 of the latter being added during the last month.

The sprays used were (1) an odorless, non-toxic, white petroleum oil of western origin, and (2) a combination of 2 parts of the former and one part of an oil used for household spray containing an extract of pyrethrum in distillate. Though both were on the market under specific names, in this report they will be referred to as the white oil and yellow oil, respectively. The cows in groups A and B were sprayed with the yellow oil, while the white oil was used on groups

C and D. A pressure tank gun was used, about 400 cc. being applied daily to each cow.

The Combined Effect of Spray and Flies

The physical appearance of the animals after spraying was satisfactory. The oil collected very little dust, and the coats seemed sleek and soft. There was, however, a distinct falling off in milk production. Because group A, now being sprayed with yellow oil, could no longer serve as a control, the expected production of each group was arrived at by using the rate of decline for that month exhibited by the 10 cows in the college herd previously used for this purpose.

Table 2 summarizes the results. The animals sprayed with the yellow oil (white oil and pyrethrum) apparently suffered less than those sprayed with the straight white oil. Group A failed to make their expectancy by 4.3 per cent. Group C, which had suffered a loss of 9.3 per cent as the result of flies-alone, now showed a decrease of 12.4 per cent. This increased loss is similar to the loss of 4.3 per cent exhibited by group A, which can be chargeable only to spray injury, as no flies were present.

With the straight white oil the results were more striking. The cows infested with horn flies, group B, which had suffered a reduction of 1.4 per cent with flies alone, now registered a loss of 13.1 per cent. Group D, now with stable flies, suffered a 21 per cent loss contrasted with the 9.3 per cent caused by stable flies alone.

Effect of Spray on the Flies

The white oil had very little effect on any of the flies. Horn flies caught in the vortex of the spray were killed apparently by mechanical action. Stable flies were slightly more susceptible than house flies in the case of a "direct hit." Thirty-six out of forty house flies placed in the center of a target that received (at the point where the flies were held) .05 grams of oil per square inch lived longer than controls that were not sprayed. Stable flies were invariably killed by this treatment, and when forcing their way through the oily hair of a sprayed cow often retreated and attempted to clean themselves. House flies, however, were not visibly affected by the presence of the oil on the cows.

The yellow spray had a definite toxic effect noticeable for several hours. The pyrethrum-oil portion of the spray was readily volatile, all effects, if used alone, disappearing in approximately forty minutes. When combined with the white oil, it remained effective for three or four hours, gradually losing its repellent properties until it was innocuous at the end of about 7 hours. Flies

not repelled were paralyzed soon after alighting on the freshly sprayed animals. About half of these soon died; the others gradually recovered. Those ravenously hungry when liberated in the stalls attacked the animals in spite of the spray, and if they persisted long enough, were killed; but those not so hungry waited on the sides of the stall until the repellent action diminished.

The loss in milk production attributable to flies was as follows: horn flies, 1.4 per cent; house flies, 3.3 per cent; stable flies, 9.3 per cent. When a bland nontoxic oil was applied in the presence of stable flies, the loss in production was 21.0 per cent; in the presence of horn flies it was 13.1 per cent. When pyrethrum, extracted in a light oil, was added to the above spray and applied in the absence of flies, the resulting loss was 4.3 percent; when stable flies were present it was 12.4 per cent.

The 1926 Experiment

Our findings—that sprays applied in the absence of flies caused a marked reduction in milk, greater even than that resulting from a heavy infestation of stable flies— if substantiated, would be valuable information for the dairyman and spray manufacturer. Because of these facts, the work during the summer of 1926 was intended to check our previous findings on this point and to discover if possible the reasons why a loss in milk production should result from the use of fly spray.

During periods of high temperature, the clinical picture of the oiled cows was one of extreme distress, while the untreated animals were affected but little. To a lesser extent this was true of the group sprayed with pine tar-creosote. Respiration counts and body temperature readings were taken at 2 hour intervals throughout the day.

While the normal body temperature of the cow lies usually between 101 and 102° F., it may at times reach 103° F. In spite of the stupendous effort being made by the sprayed animals to maintain a normal body temperature, as evidenced by the extremely rapid respiration of 130 breaths per minute, their average body temperature was of fever proportions, being 105.1° F. The unsprayed cows, on the other hand, were not greatly affected, as shown by an average of 102.9° F. for body temperature and a respiration rate of 85 per minute. That the fly spray was responsible for this fever and rapid breathing is further indicated by the fact that in the case of the untreated cows, there was little if any relation between environmental temperature and

the respiration rate and body temperature.

On the advice of the University veterinarians, spraying was discontinued and the cows washed repeatedly in order to avoid permanent injury. Immediate relief followed each washing but the distressed condition was again evident in a few hours, about a week being required before normal body temperature and respiration returned permanently.

The comfort of the cow, as affected by temperature, humidity, and air movement has an important bearing upon the amount and quality of milk she is able to produce.

The general conclusion to be drawn from these trials is that the application of fly spray augments the relatively small losses attributable to fly annoyance. This conclusion is distinctly at variance with the popular belief that flies exact a heavy toll, which is minimized by spraying.

It is not difficult to see how the dairyman has been led to this belief. The comfortable surroundings and excellent feed conditions that exist naturally in the spring and early summer make this season ideal for milk production. The appearance of flies in greatest numbers is coincident with the onset of summer heat and the drying up of the pastures. It is not surprising then that the dairyman should attribute to flies the marked decline in milk flow caused by hot weather and under-nutrition. Moreover, his faith in the efficacy of fly repellents has been fostered by the sales promotion activities of spray manufacturers and by the advice of certain experiment station and extension workers.

In our studies, the exposure of cows to stable fly infestations many times more severe than would be found under ordinary field conditions (the screened stalls were literally swarming with flies) resulted in less than a ten per cent loss in production. Invariably, however, this loss was about doubled when oil sprays were used to protect the cows, especially in hot weather.

When the average daily environmental temperature remains at 80 or 85 degrees F., depending upon the breed, for more than 24 hours, the heat regulating mechanism ceases to function adequately and the cow exhibits symptoms of distress. At this critical temperature, which we have called the "pyrexial point," her body temperature rises, her milk flow declines, and the physico-chemical characteristics of her milk are altered.

The kind of spray, the amount applied, the productive capacity of the cows, and the environmental temperature are all important factors in determining the de-

leterious effect of the spray. This is most marked when the high producing cow is treated with a generous application of a petroleum base spray in hot weather.

In view of the small losses that may be rightfully charged to flies, it is difficult to see how the use of sprays can be justified on economic grounds alone.

Conclusions

(1) The loss in milk production caused by flies is often overestimated. When high producing cows were exposed to extremely heavy infestations, the loss occasioned by house flies and horn flies was negligible; that caused by stable flies was slightly less than 10 per cent.

(2) Fly sprays of petroleum oils carrying pyrethrum or pine oil or both were tested. All had the same repellent efficiency for the first hour but differed at subsequent intervals. Pine oil increased their efficiency in proportion to the amount added.

(3) Burning of the skin followed the use of oils having a viscosity lower than 40 seconds, irrespective of the unsulfonated residues; while oils with unsulfonated residues below 90 percent were dangerous, when used in oils of higher viscosity than 65 seconds.

TABLE 1

Losses in milk production resulting from heavy infestations of flies

Group	Treatment	Average Monthly Milk Production		Losses Attributable to Flies	
		Expected lbs.	Actual lbs.	Lbs.	Per cent
A	No flies	...	954	..	..
B	73,000 horn flies	677	667	10	1.4
C	71,000 stable flies	1055	957	98	9.3
D	140,000 house flies	890	860	30	3.3

TABLE 2

Losses in production resulting from the use of petroleum sprays during a heavy infestation of flies

Group	Treatment	Average Monthly Milk Production		Loss in Milk Production	
		Expected lbs.	Actual lbs.	Lbs.	Per cent
A	Yellow oil—no flies	942	900	42	4.3
C	Yellow oil—23,250 stable flies	986	862	124	12.4
D	White oil—26,900 stable flies	887	692	185	21.0
B	White oil—19,600 horn flies	654	566	98	13.1

(4) When petroleum sprays were used to repel the stable flies, the loss in milk yield was increased to 22 per cent.

(5) The extreme effect was evident when high producing cows were sprayed during hot weather. Not only was production diminished but the body temperature and respiration rate were elevated. Dry cows exhibited no increase in temperature or breathing rate when sprayed.

(6) The application of oil produces on the skin a definite physiological effect, impairing its ability to aid in maintaining body temperature.

(7) The hourly loss of water through the skin of the unsprayed cow at 84° F. and 60 per cent relative humidity, was 413 grams, while for the sprayed animal this figure was 223 grams. This represents a loss of 46 per cent in cooling, due to the loss in evaporation of water from the skin.

(8) When 40 cc. of commercial spray was applied at an environmental temperature of 80° F., the upper critical temperature or "pyrexial point" of the cow was lowered approximately 5° F.

(9) A water emulsion of pyrethrum and pine oil combined with a small amount of petroleum was as efficient in repelling flies as the petroleum sprays and was less detrimental to the cows.

Calibrate the Seed Drill

W. C. Krueger

(Reprinted from the May issue with corrections)

MANY seed drills do not sow the indicated rate per acre. This wastes seed or land and invites poor stands. Drills should be calibrated periodically to guide adjustments or so that allowances can be made.

To do this, first multiply the effective width of the drill in feet by the circumference of the wheel and divide the product into 43,560, the number of square feet per acre, to determine how many turns of the wheel should be made as a basis for the test. The result will be the number of times the wheel must turn to give the equivalent of one acre of coverage. Raise the drill to free one wheel, set rate dial or gauge at required quantity per acre and run seed through drill by giving the wheel the required number of turns.

Checking the quantity actually run through against that indicated will reveal the margin of error if there is any. Correction in setting of the drill to obtain the desired rate of planting can then be made. Calibrating requires less than one hour's time and is well worth doing.

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INDEX

Cattle

...-Feeding Calves ..... Jan., 1938
...r Herds Make the Forage
...Market ..... March, 1938
...d Production Costs ..... March, 1938
...ening Calves on Milo Grain .. March, 1938
...f without Grain ..... April, 1938
...ening Cattle on Pasture ..... July, 1938

...rvation

... Conservation Service ..... Feb., 1938
... Menacing Morning Glory ... March, 1938
...ner in Conservation ..... July, 1938

...

...Creeping Alfalfa ..... Jan., 1938
...ping Off of Cotton ..... Jan., 1938
...dlaria is Good for Southern Soils Feb., 1938
...Grass that Fattens ..... Feb., 1938
...age Crop Engineering ..... March, 1938
...est Profit ..... March, 1938
...r Old Friend Timothy ..... March, 1938
...e Crops ..... March, 1938
...ger of Unadapted Clover Seed April, 1938
... Adventure in Grass Farming . April, 1938
...ley's Future ..... May, 1938
...reasing Protein Content of Timothy, June, 1938
...ding Hybrid Seed Corn ..... June, 1938
...rways ..... July, 1938
...n There's a Snake in Sudan Grass, July, 1938

... Cattle

...d Feeding ..... Jan., 1938
...ke Feeding ..... Jan., 1938
...ing Dairy Calves ..... Feb., 1938
...x Ghosts ..... March, 1938
..., the Basis of Breeding .... March, 1938
...duction Records ..... April, 1938
... High Testing Cows Produce More Fat? May, 1938
... Treatment for Mastitis ..... May, 1938
...lah Dairying .....
... for Livestock Improvement .. June, 1938
...gh or Low Pressure Dairying .. June, 1938
...ding Experiments ..... July, 1938
...ficial Breeding Society ..... July, 1938

... Machinery

...ctor Gas Engine Troubles ..... Feb., 1938
...ctor Costs Then and Now ..... Feb., 1938
...ctor Care ..... May, 1938
...es of Pumps for Farm Use .... July, 1938

...

...ple Scab Can Be Controlled .... Jan., 1938
...minating the Dwarf Fruit Tree Feb., 1938
...ation of Fruit Trees ..... March, 1938
...ch Mosaic ..... March, 1938
... Man Behind the Spray Gun . April, 1938
...berry Varieties ..... April, 1938
... Manchu Apricots ..... May, 1938
...matic Bearing ..... May, 1938
... Varieties of Tree Fruits ..... June, 1938
... Aspects of Fertilization ..... June, 1938
...ard Irrigation ..... July, 1938

Fertilizers

Fertilizer Analysis ..... March, 1938
Mixing Your Own Fertilizers .... April, 1938
Fertilizer Placement ..... May, 1938
Fertility Loss Must Be Figured .. May, 1938
Small Tonics Increase Yields ..... June, 1938
Phosphatic Fertilizers ..... July, 1938
Fertilizers for the Dairy Farm .... July, 1938

Hogs

Pre-farrowing Management ..... March, 1938
Studies in Hog Type ..... April, 1938
Swine Sanitation Plan ..... April, 1938
Pig Yardstick ..... May, 1938
Outbreeding Best ..... May, 1938
No Pig Wants to be a Runt ..... June, 1938
Pigs, Pasture and Protein ..... July, 1938

Horses

That Dread Horse Disease ..... April, 1938
Minerals and Good Horses ..... July, 1938

Pastures

Intensive Pasture Management .... Feb., 1938
Seeding Permanent Pastures .... March, 1938
Improving Depleted Ranges ..... April, 1938
Pasture Improvement ..... May, 1938
New Models in Pasture Plants .... May, 1938
Longer Grazing Seasons ..... June, 1938

Poultry

Incubation the Crucial Period ..... Jan., 1938
Watch Winter Egg Yields ..... Jan., 1938
Fattening for Better Profits ..... Jan., 1938
Shall We Heat the Laying House .. Feb., 1938
Fresh Air in the Incubator ..... March, 1938
Producing Market Eggs ..... April, 1938
New Turkey Disease ..... April, 1938
Batteries vs. Range System ..... May, 1938
Internal Quality of Eggs ..... May, 1938
These Frozen Eggs ..... May, 1938
Battery Brooding ..... June, 1938
Individuality Among Hens ..... June, 1938
It Pays to Insulate ..... June, 1938
Milk Increases Turkey Profits .... June, 1938
Manganese Prevents Slipped Tendons, July, 1938
Ventilation for Poultry Houses .... July, 1938

Sheep

Cornbelt Sheep ..... March, 1938
Wool ..... April, 1938
Sheep Scab Mite ..... July, 1938

Silage

Straw Silos ..... Feb., 1938
Grass Legume Silage ..... July, 1938

Vegetables

Conn. Straightneck Squash ..... April, 1938
Tricks in Veg. Breeders Trade ... April, 1938
Growing Trellis Tomatoes ..... May, 1938
Know Your Spinach ..... May, 1938
Nutritional Requirements of the Tomato, July, 1938

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